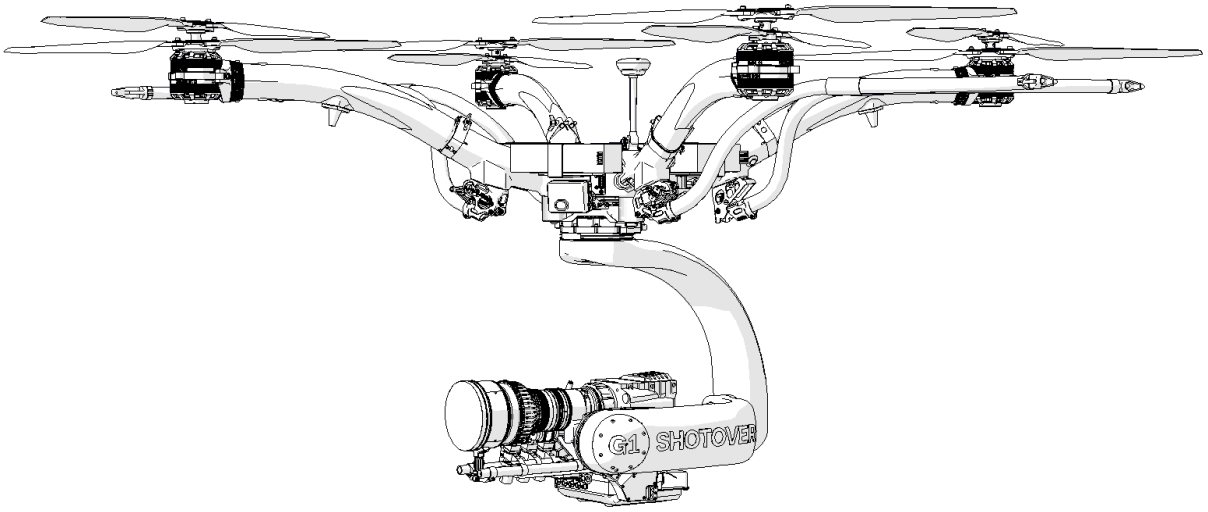
SHOTOVER



MultiRotor UAV &
Three Axis Stabilized Camera Platform

U1 Owner's Manual

002-9059
Rev. 2.2
May 2021

REVISION HISTORY

Revision	Description	Date
2.0	Added Cube FC information	Mar 2018
2.1	Added Cube FC user configurable settings and motor mount weight limitations.	May 2018
2.2	Corrected String Orientation	May 2018
2.2	Series II Propulsion	May 2021
2.2	Parachute for Series II	May 2021

Table of Contents

1 Overview

This document provides information to assist with the setup, installation, and operation of the SHOTOVER Camera Systems U1 multirotor. This manual should not be considered a substitute to a SHOTOVER approved training course, required before operating your SHOTOVER U1 System.

Disclaimer

Due to continuous product improvement and development, the SHOTOVER Camera Systems U1 features and operation may change at any time and without notice. Before installing any software updates, always read the release notes, and the latest version of this manual.

Please contact SHOTOVER Camera Systems for the latest version of this document.

General Safety

- Read and understand all safety and operating instructions before setup, installation or operation of the system.
- Heed all safety warnings and cautions on the equipment, and those contained within this manual.
- Do not use accessories or attachments unless approved by SHOTOVER Camera Systems. Damage sustained through use of unsupported accessories will invalidate the warranty.
- Do not cover fan openings in the Ground Station.
- Do not disable any safety features of the system.
- Use only factory specified replacement parts.
- Follow static control procedures when in proximity of an exposed circuit board.
- Follow proper engineering practices.
- Ensure proper power and grounding of the system.
- Replace any fuses or circuit breakers only with factory specified type to avoid fire hazard, and potential damage to the system.
- Route all system cabling in such a way as to ensure they cannot be damaged.
- Ensure all system components are connected, and the payload is fitted and balanced correctly before powering on the system.
- To avoid injury to yourself and damage to the equipment, have the camera system serviced by qualified personnel only.

Caution Notices

Cautions indicate a possible safety risk or a risk of damage to the equipment.

Cautions are indicated throughout this manual on hazards that present danger of damage to the SHOTOVER Camera System during a particular operation or service.

Observe the following cautions when working with SHOTOVER Camera Systems equipment.

Warning Notices

Warnings indicate a possible safety risk or a risk of injury to both the operator and equipment.

Warnings are indicated throughout this manual on hazards that present danger to personnel, and may cause injury or death if performed incorrectly or carelessly.

Observe the following warnings when using or working on SHOTOVER Camera Systems equipment.

2 System Specifications

Complete MIMO Single Link HD Downlink

- Gimbal communication
- Camera communication
- 2 x HD video (From G1 Gimbal)
- POV camera HD Video

Dimensions

- Height: 894mm
- Width: 979mm (without props), 1668.5mm (with props)
- Wingspan: 1385mm (without props) 2083.5mm (with props)

Flight Time

- Up to 22min *dependent on setup

Power

- 500 Amps Max Draw (at 44V)

Maximum Battery Length

- 190mm

Operating Temperature

- -20 to +40 °C (-4 to 104 °F).

Weight

- Empty weight (without batteries): 11kg
- Payload weight: Max 12kg
- Total weight: 34kg

Main FC – The Cube with ArduCopter

- 3 IMU's
  1 Fixed 10 Axis IMU on the main Main board.
  2 Vibration Isolated and heat controlled 9DOF IMU's and an isolated Baro.
- ArduCopter Open Source Firmware

For more detailed specs:
http://www.proficnc.com/content/13-pixhawk2

Secondary FC – The Cube with ArduCopter

- 3 IMU's
  1 Fixed 10 Axis IMU on the main Main board. 2 Vibra on Isolated and heat controlled 9DOF IMU's and an isolated Baro.
- ArduCopter Open Source Firmware

Motors

- Co-axial custom motor design
- Two independent KDE 7215XF motors per rotor arm
- Kv: 135 RPM/V
- Maximum Continuous Current: 85+A (180 s)
- Maximum Continuous Power: 4405+W (180 s)
- Voltage Range: 50V (12S) (44V nominal)
- Weight: 555 g (640 g with wires/bullets)
- Maximum Thrust Output: 142.98 N
- Maximum Power Input: 2581 W
- RPM: 4775 rev/min

*** Notes:**

a) These values are drawn from KDE, and are obtained under their specific testing conditions.
For more detailed specs:
https://www.kdedirect.com/products/kde7215xf-135

Overall Specifications:

- Maximum Thrust: 1143 N or 380% lift power
- Maximum Power Input: 20.648 kW
- Type: Direct connection
- Motor Fixation: Rigid
- Diameter of the Fittings: 3mm (M3)

Propellers

- Model: T-Motor FA27.2×8.9
- Type: Rigid
- Number of blades: 16
- Diameter: 27.5 inches
- Pitch: 8.9 degrees
- Blade Material: Carbon Fibre
- Hub Material: Aluminium
- Manufacturer: T Motor
- Fittings :4 type M3 x 8mm

*** Notes:**

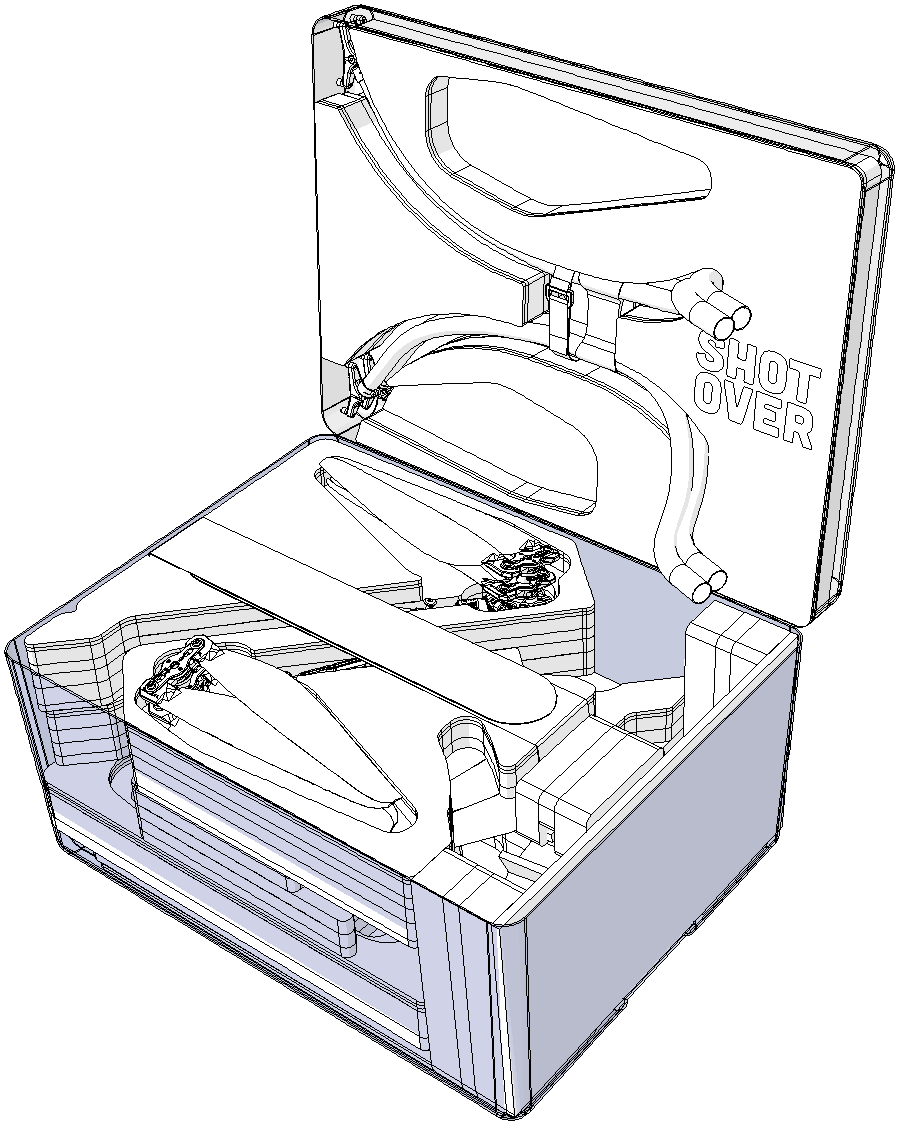
a) Propellers are a matched pair, and should not be mixed and matched during assembly, refer to the KDE website for more detailed information.
b) Consequently, the U1 Multirotor will have four pairs of CW rotating propellers and 4 pairs of CC rotating propellers.

Recommended Environmental Operating conditions

- Rain: Nil
- Wind: 40km/h (max)
- Snow: Nil
- Hail: Nil
- Altitude: 8000ft

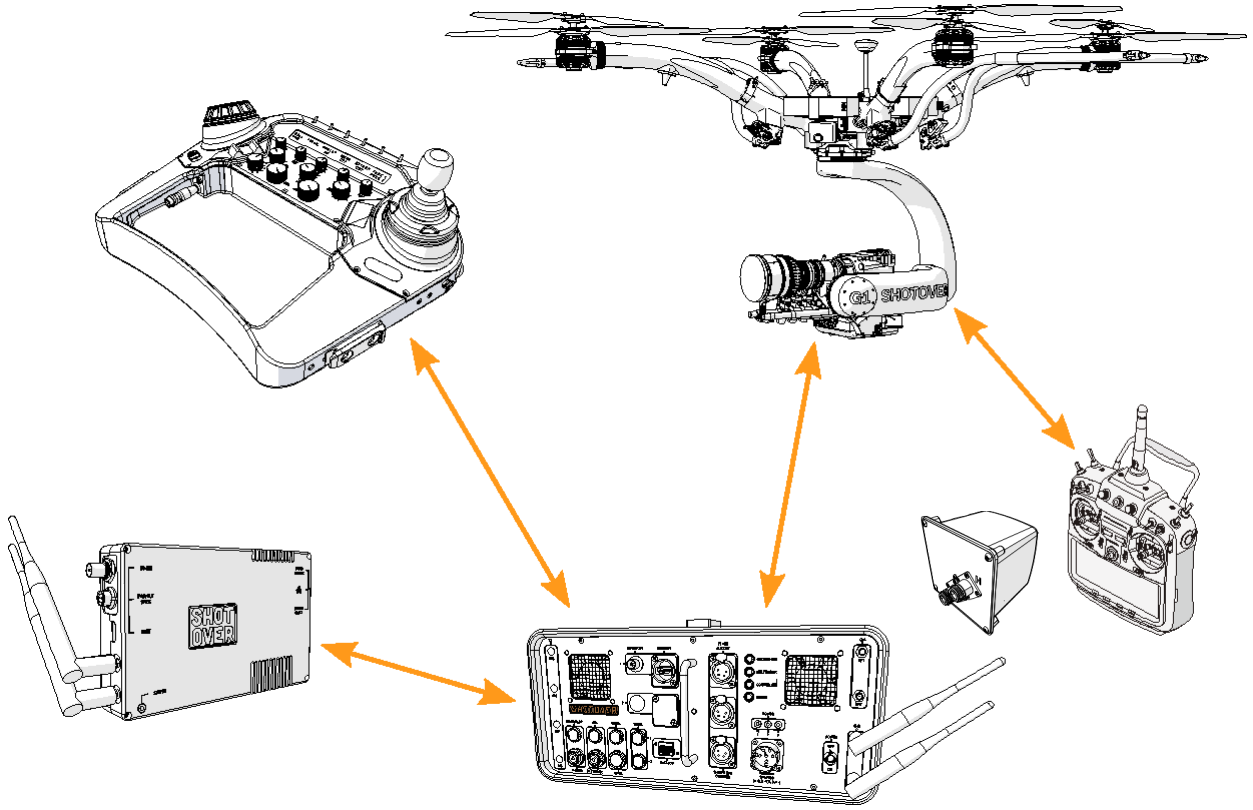
3 Transportation

The U1 system comes in one 1630 pelican case.



4 System Overview

Every U1 has passed extensive quality control and flight testing. After having completed your SHOTOVER approved training course, required before operating your SHOTOVER U1 system, all that is required, on your behalf, is to familiarise yourself with the system, set the compass for your location, and your transmitter.



U1 System Diagram

Flight Controllers

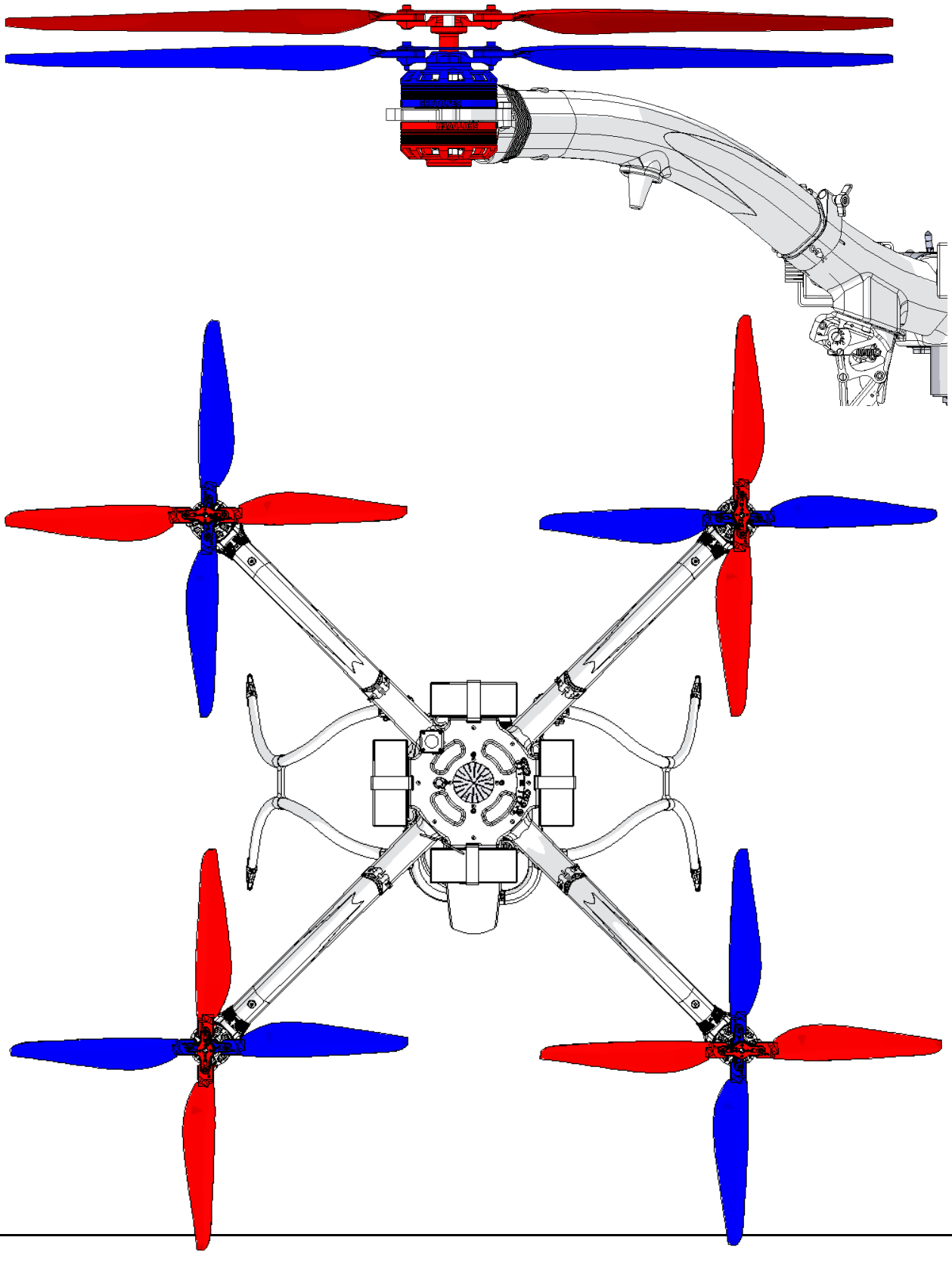
- The Cube is the primary controller.
    - This is fully tuned, and fully functional, with 3 flight modes.
    - Upon powering up the system, The Cube will have control, regardless of the transmitter's flight mode switch position.
    - If you find that your switch is selected to secondary FC after powering up, switch it to the Primary (The Cube) and ensure the Pilot monitor, or, alternatively the WebUI is not showing the secondary flight controller in control.
- The Pixhawk is the secondary flight controller.
    - This system slight controller is tuned to allow for a smoother and reliable transition in flight.
    - There is no GPS installed. Its sole purpose is to allow the pilot to safely land the system in case of an inflight failure.
    - The flight controller will default to "stabilised mode", and has no other pilot aids operational.
- The pilot, via their transmitter, is the only person who has control of the switchover, the U1 will not automatically switch.
- Once the secondary flight controller is selected, the system must be landed and repowered before you can switch back to The primary flight controller (The Cube).

Once the secondary flight controller is selected, it is recommended that you land as soon as possible. We do not recommend continuing to fly the system on the secondary controller. Investigate the cause of the failure once landed.

Lift Motors and Configuration

The SHOTOVER U1 uses the OVERDRIVE co-axial custom motor design. It consists of two KDE 7215XF motors per rotor arm, for a total of eight KDE 7215XF motors in the U1.

Configuration and Direction of Rotation



Motor Mounts

WARNING There are two motor mount options currently in use. The motor mounts must not exceed there weight limitations.

Heavy Lift Motor mount.

Max AUW (all up weight) of the U1 - 34kg

Ultra-heavy lift Motor Mount.

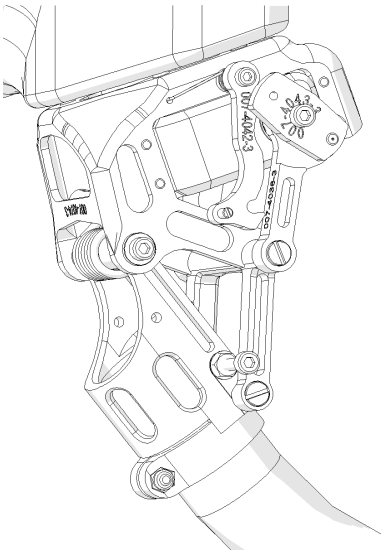
Max AUW of the U1 – 40kg

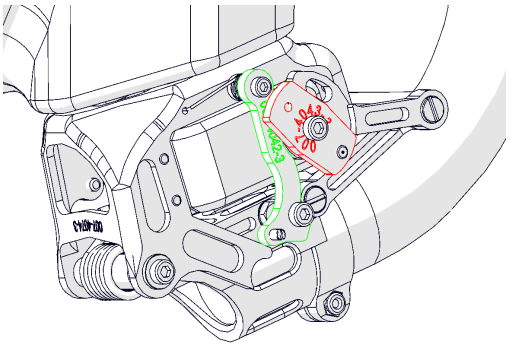
Landing Gear

- The Landing gear default position on power up is down, regardless of the transmitter switch position.
    - When powering the system on, the landing gear mechanism will automatically travel to the lowered position.
    - If the transmitter switch is in the raised position on power up, you can switch to the correct position without the landing gear moving.
- The landing gear is controlled by the U1 Brain Board.
    - This controls the power and driving of the servos.
    - Any changes made to the transmitter endpoints or sub trim will not correspond to changes in the mechanism of the landing gear.
    - The landing gear will automatically lower when:
        - The voltage drops below 42v for 1 second or more.
        - Return to Home (RTH) is triggered.
        - Transmitter link is lost.
        - The system determines there is a critical fault.
- The Landing gear mechanism is mechanically locked in both the retracted, and down position. This means the servo will not overheat during the flight.
    - In the down position, the landing gear mechanism is over-centred, preventing the leg from collapsing.

- In the retracted position, the leg is held by a small catch that allows the servo to be load free after 2 seconds of being in the fully retracted position.
- To override this lockout for storage:

WARNING: Once the over centre retention has been overcome, the spring will try to close the mechanism. Ensure your fingers are clear of any possible trapping points.





Power Supply Redundancy

There are multiple 12v and 5v power supplies on the brain. These are all linked to provide a constant power source to the flight controllers, and the brain itself.

If one of these power supplies fails, the others will continue to provide power. In the event of a failure, a warning will be displayed on the overlay, indicating that a power supply has failed, and the WebUI Air tab will highlight a failure with a red box surrounding the current voltage. The remaining supplies are still working, but you should land as soon as possible.

MultiRotor Transmitter & Receiver

Receiver

SHOTOVER supplies a Futaba R7008 FAAST Receiver as standard.

Transmitter

SHOTOVER does not supply a transmitter for the U1.

Transmitter Requirements:

- 14 or more PWM Channels
- FAAST Compatible
- 2.4GHz transmission

Channels and Receivers

The Futaba 18SZ and 18MZ both have the capacity to transmit on a range of 18 channels, and receive on a range of 8 channels, depending on configuration.

A Futaba 18MZ & SZ configuration file can be downloaded from Service & Support Portal, and imported into the controller.

Battery Redundancy

The U1 has the ability to disconnect a string of batteries, to protect the system from a battery failure. In order to have this redundancy, two sets of batteries must be connected.

One string is considered as two 6S batteries, on opposite sides of the hub.

When two battery strings are in use, the system will automatically switch off the faulty string in the following circumstance:

1. Negative current is detected. i.e, when a fully charged set of batteries are plugged in and the second set is discharged, a negative current is detected. A short circuit in a battery string will also cause a negative current situation.

The individual battery cells will also be monitored, and warnings will be displayed if a cell voltage exceeds the thresholds in place. i.e. 11 cells are at 4.15v and 1 cell is at 3.9v. The battery string will not be disconnected if this occurs.

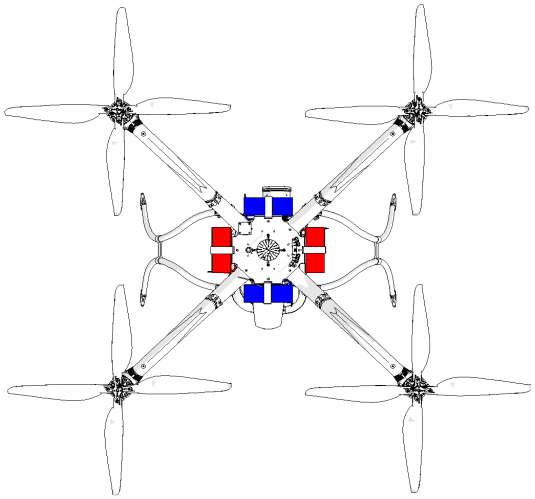


Figure 6

Ground Station (GS)

The Ground Station is the centre of all communications and telemetry for the G1 and U1 video components.

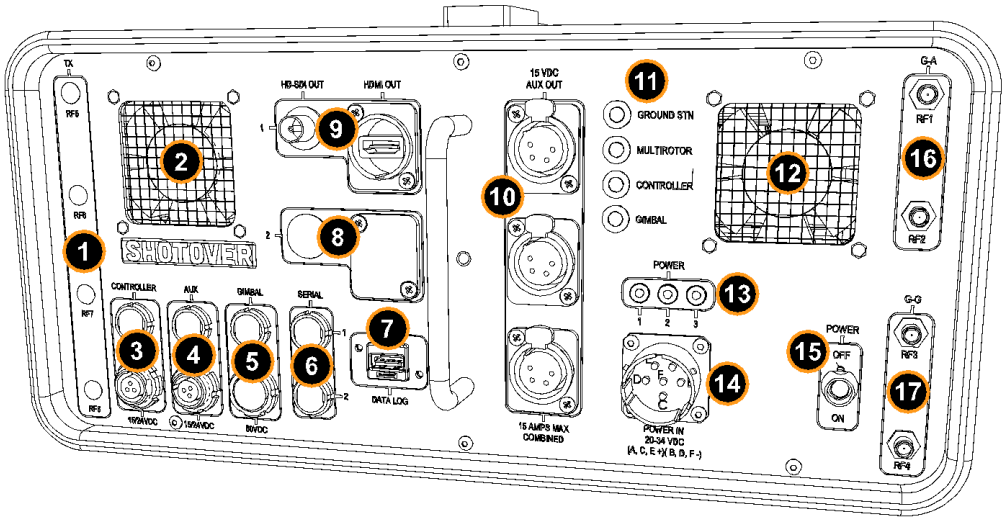


Figure 7

ID	DESCRIPTION	QTY	DETAILS
1	Antenna Connections	4	For future use
2	Fan	1	AirFlow Out
3	GCU Connections	1	Hardwire GCU power and comms connections
4	Aux Connections	1	Additional hardwire power and comms connections
5	Gimbal Connections	1	Hardwire gimbal power and comms connections
6	Serial Connections	1	RS422 (Configurable for RS232) & RS485 ports
7	USB Port	1	For connecting USB recovery disk
8	Blank Ports	2	Not used
9	Gimbal Video Outs	2	Gimbal monitor SDI and HDMI
10	Aux 15VDC Power	3	4pin XLR power for accessories
11	System Status LEDs	4	GS, U1, GCU and G1 status LEDs
12	Fan	1	Airflow In
13	Power Status LEDs	3	
14	Power Input	1	20-34V power input (A-C-E positive, B-D-F negative)
15	Power Switch	1	On/Off Switch
16	Antenna Connections	2	Ground to System antennas (G-A)
17	Antenna Connections	2	Wi-Fi Output antennas (G-G)

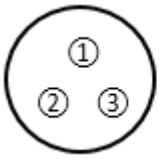
Features

- Supports wired operation – Allowing the Free Runner to be used on long shoots, without time consuming battery changes and charging.

- Output video via HD-SDI & HDMI – Allowing the operator an accessible view of ongoing footage, regardless of the cameras location.
- Access point for wireless video transmission to handheld devices – Coming in later software release.
- Wired connection point for video recorder.
- One RS422 port intended for connection of a non-displacement Joystick or wheels. This port can also be configured for RS232.
- One RS485 port intended for connection of a Preston Gimbal Control Unit.
- USB port for connection of a USB recovery disk.
- Multi-colour LEDs will indicate the status of Ground Station, Multi Rotor, Gimbal Control Unit, and Gimbal.

Power

- Input voltage range of 20-34 VDC 1.2kW.
- Maximum current draw of 60 Amps.
- 3 pairs of 12AWG wires for power input. Current must be shared across all 3 pairs of pins.
- If an incorrect polarity power supply is connected, the Ground Station will be disabled and not draw current.
- The Battery LEDs indicate the presence of a battery and its polarity – green is correct, red is reversed.
- Current capacity of 69A with 3 parallel batteries.
- Hot swap functionality will be provided via the U1 Battery Bank (not included)
- Outputs:
    - 55 volts to the Free Runner/G1
    - 3 x 15V XLR power outputs
    - 15/24 volts for:
        - Gimbal Control Unit power
        - Pilot Monitor
        - Auxiliary devices like hand wheels etc.



1 = +15V, 2= GND, 3 = +24V

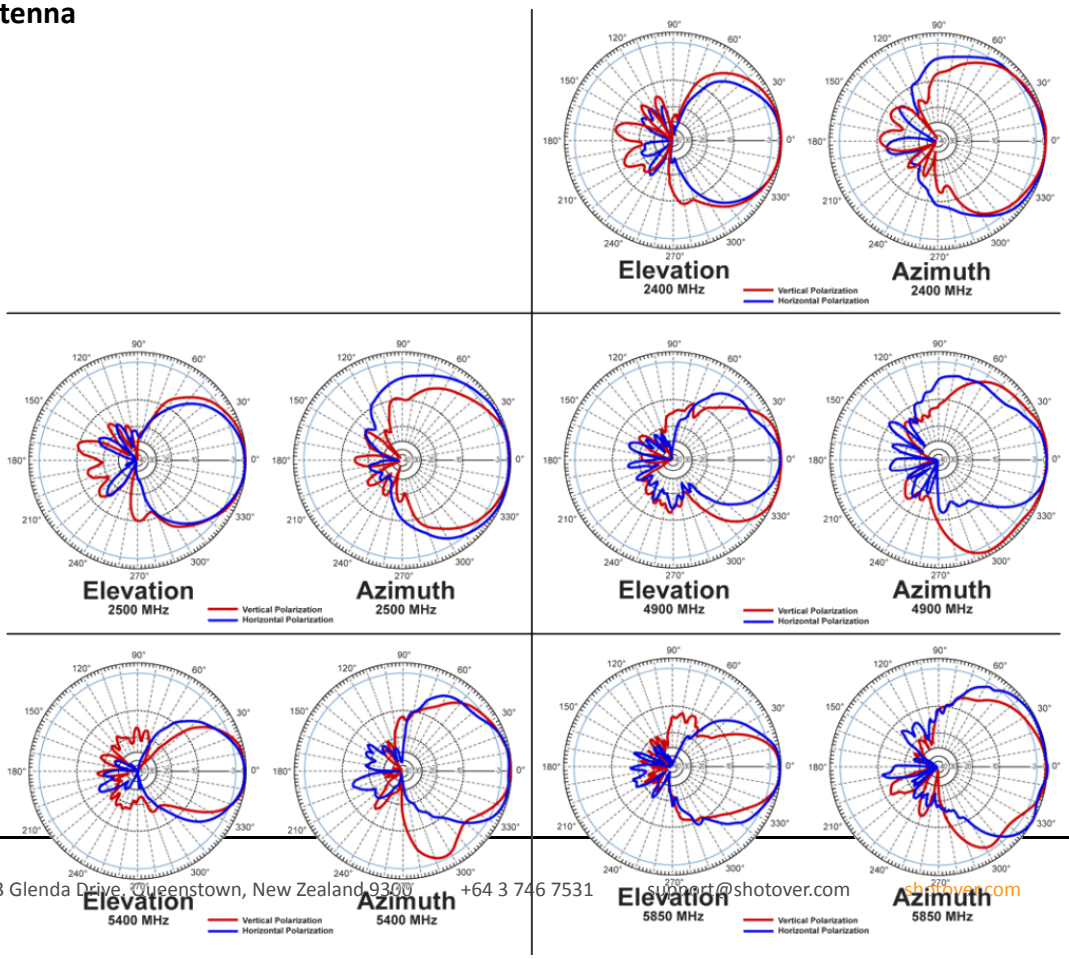
Wireless Link

- 4 RF Antennas, enabling the wireless ground-to-ground, and ground-to-air linking, are critical to the U1 versatility and performance.
- Complete MIMO HD downlink and antennas.

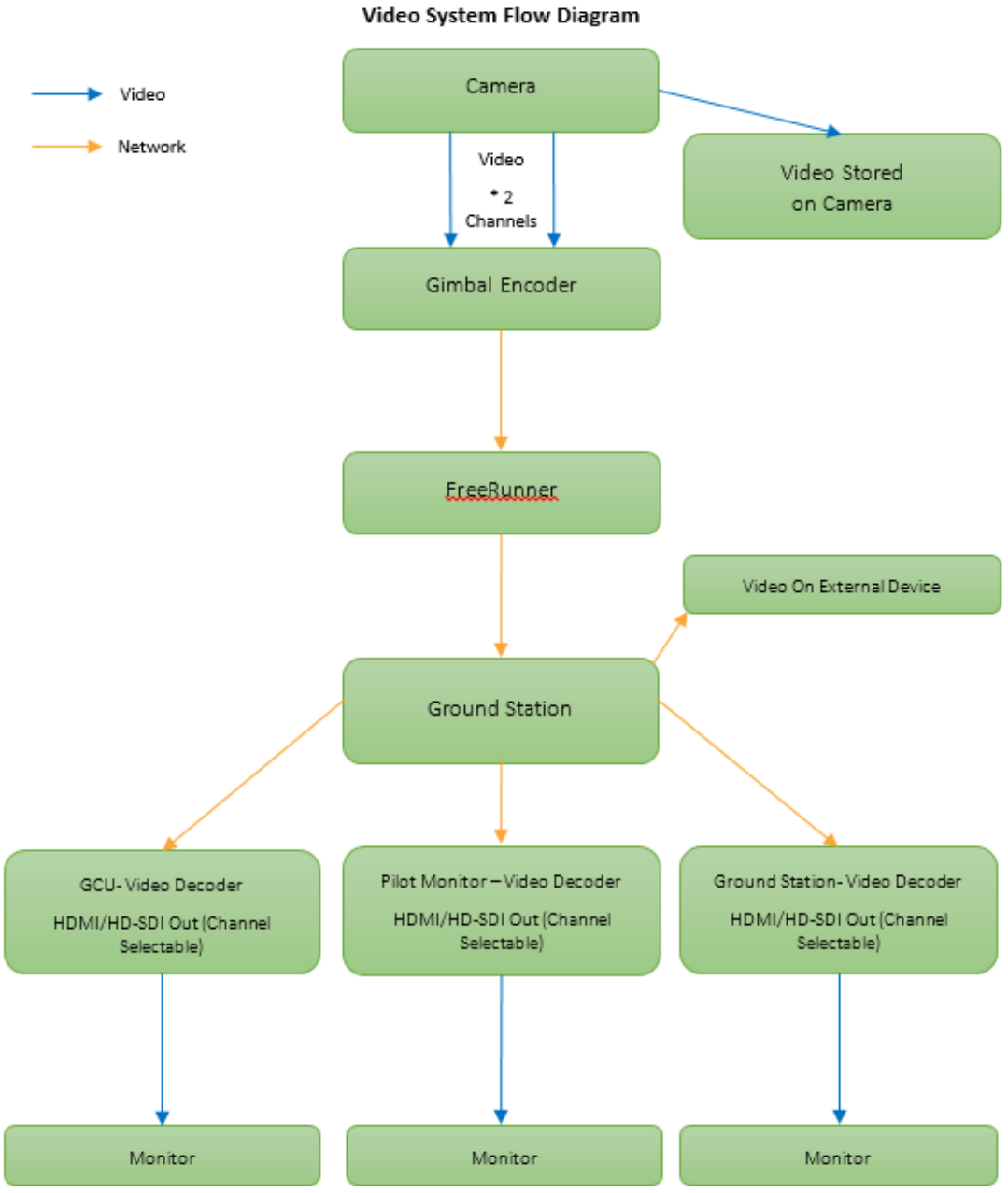
U1 Airborne Antennas:

- Frequency Range: 2.4-5GHz
- Horizontal Pattern Type: Omnidirectional
- Vertical Pattern Type: Full
- Gain: 3dBi

U1 Ground Antenna



Video System



Pilot Monitor

Refer to the G1 user manual for operating instructions.

5 System Assembly

MultiRotor

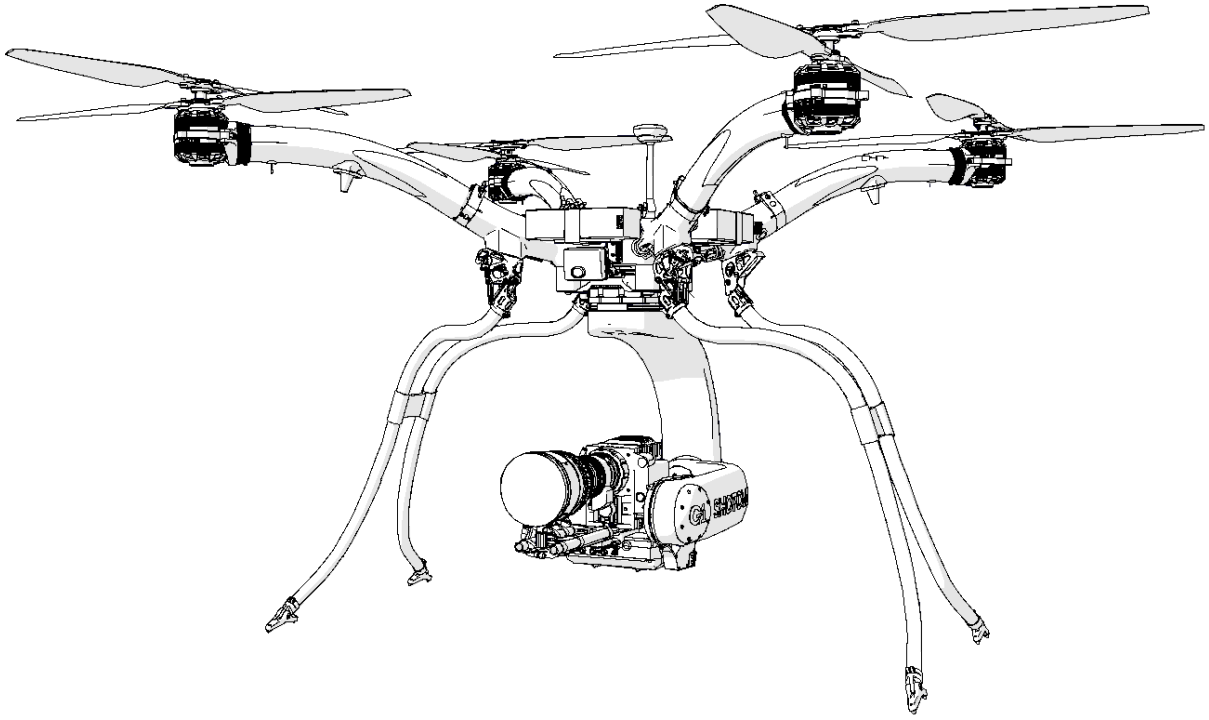


Figure 11

The SHOTOVER U1 system was designed to be assembled from the box within minutes. When you remove the U1 from its transport case, it needs to be assembled in a specific way.

To assemble the U1 multirotor:

1. Unclip and remove the landing gear from the case.
2. Using the lifting strap, lift the U1 in its foam from the pelican transport case.
3. Close the Pelican Case lid, and sit the U1 on top of the case.
4. Pull apart the Velcro on lifting strap, and remove.
5. The top two arms are taken from the foam, and inserted into the inner arms on the hub.

CAUTION: Ensure not to pinch any of the cables as they are inserted in to the carbon arms on the hub.

6. The arms can then be tightened using the clamps provided, and the safety pins inserted.

The top piece of foam can be removed to reveal the other 2 arms. These arms can now be installed to the hub using the same process.

WARNING: Ensure that all clamps are tightened, all safety pins are inserted, and all R pins installed.

7. The second piece of foam can also be removed, leaving the exposed hub with all four arms attached.
8. Lift the U1 from its final piece of foam, to gain access to the underside.
9. Check the landing gear clamps are loose, then insert the undercarriage legs in to the retracting mechanisms on the underside of the U1 hub, then secure in place with the clamps.

CAUTION: It's important to ensure the legs are installed in the correct orientation.

CAUTION: Do not over tighten.

10. Ensure the legs are seated correctly, and that the clamps are tightened.

G1 Mounting

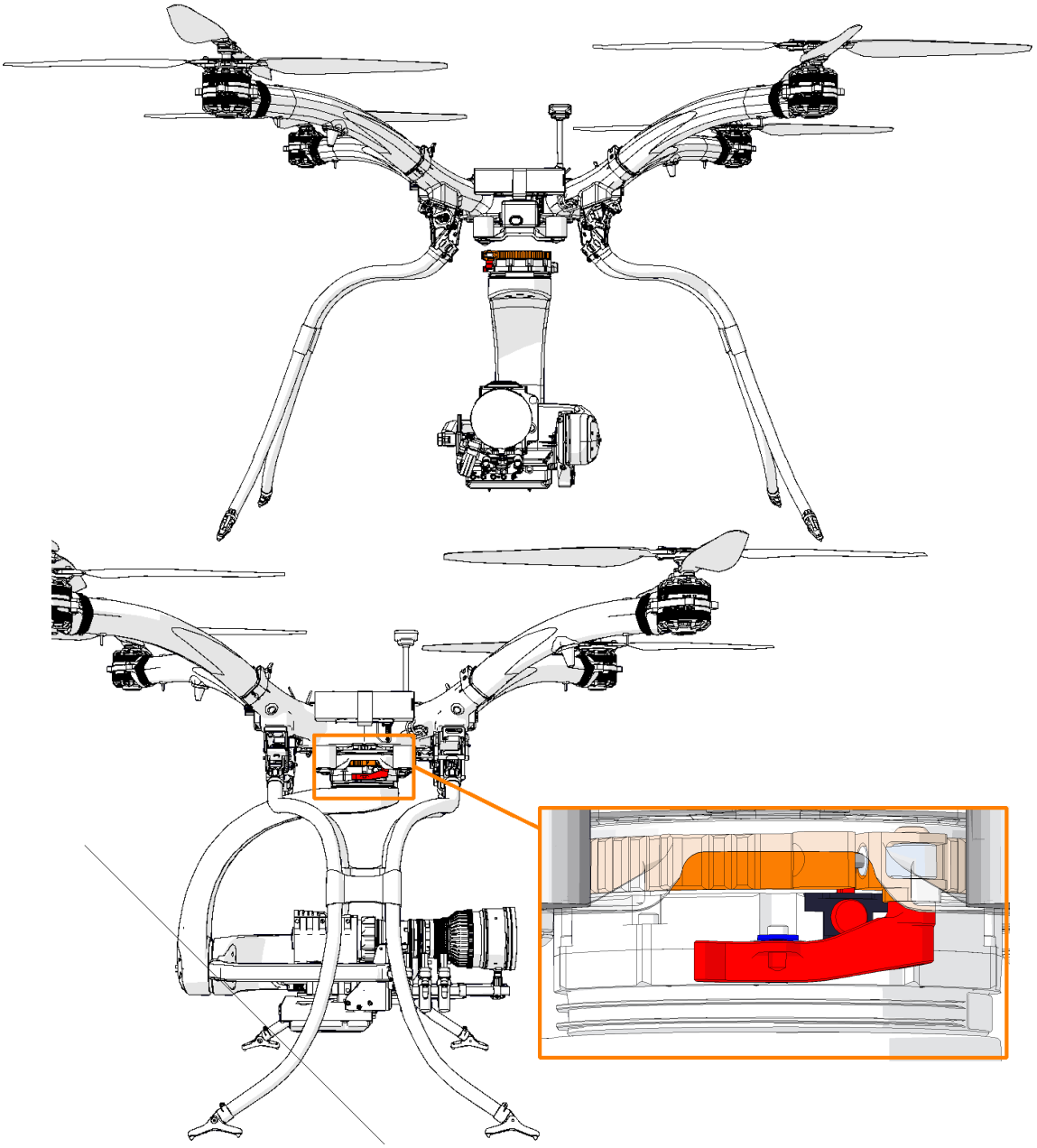
For aerial operation, the gimbal is to be mounted on the MultiRotor. The gimbal should only be mounted once the payload has been installed and balanced correctly.

In order to carry out the payload installation and balancing, follow the procedure as described in the G1 owner's manual for stand-alone operation.

1. Align the gimbal and U1 together, ensuring the locating pins are in the holes with the SHOTOVER logo facing forward – this will ensure the bayonet system is orientated correctly.
2. Turn the locking ring (clockwise when viewed from above) until it clicks into place. The circular red pin will pop out, and the locking ring will be locked in position.
3. Close the latch to snap it closed.

CAUTION: The latch should be zip tied closed as a safety precaution.

CAUTION: The latch should be firm to close, and can be adjusted by turning the M4 screw – Overtightening can cause damage or failure of the clamp, insufficient tightening could cause intermittent comms or power issues, and/or gimbal intability.



Batteries

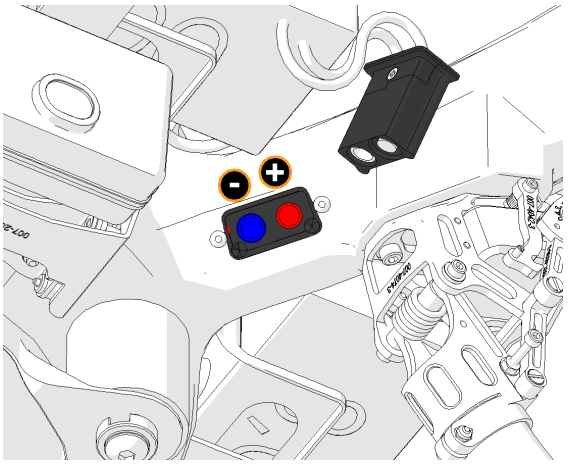
Fit a minimum of two fully charged 6S batteries (one string), onto opposite sides of the U1.

WARNING: The system has no redundancy with only one battery string fitted. See section 4, Battery Redundancy.

The U1 has custom SHOTOVER battery connectors, with AS150 terminals. When connecting batteries, offer the plug up to the socket, allow to touch, and pause for 1 second – This will minimise any sparking on connection.

Warnings

- **ALWAYS FOLLOW BATTERY MAUNFACTURERS GUIDELINES.**
- Always keep battery away from flammable objects.
- Ensure you are charging equal to, or below the battery manufacturers recommended charge rate.
- Never disassemble or modify pack wiring in any way, or puncture walls.
- Never exceed maximum discharge rate, or load.
- May explode if damaged or disposed of in fire.
- Avoid unnecessary charge cycling.



Ground Station

The ground station is required for communication between the multi-rotor and pilot monitor. For powering the ground station and other connections, see G1 Owner's Manual. Antennas should be connected as shown below.

The directional antenna should be used to maximise distance. Use cables 006-6108 to connect the directional antenna to the ground station. Polarity is not important.

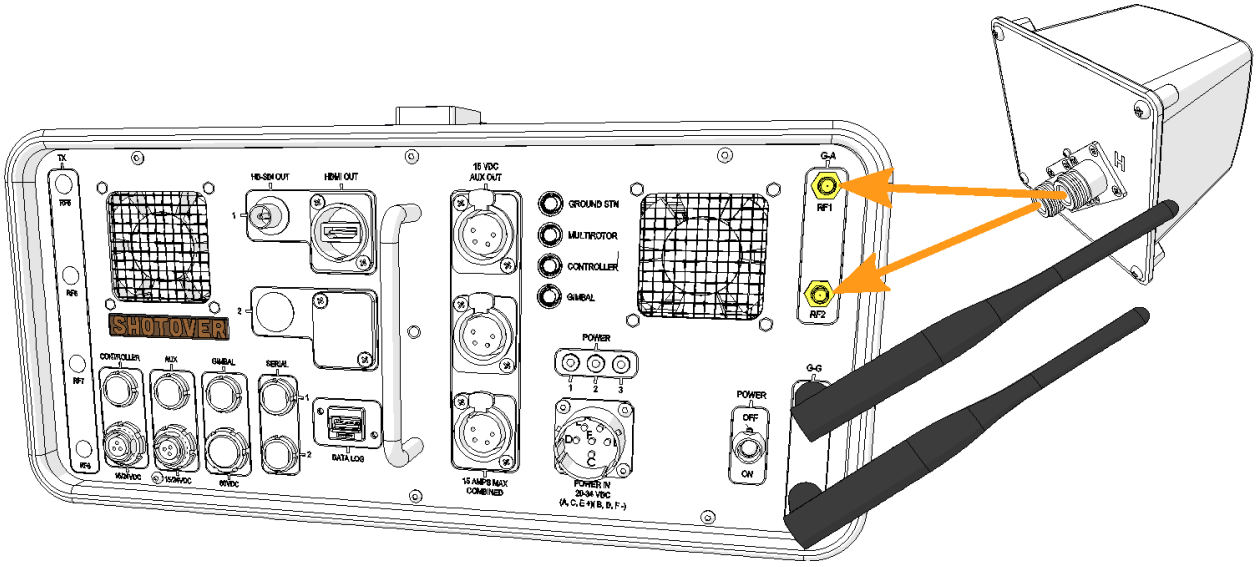


Figure 15

6 Initial Configuration

Futaba TX Setup

- The Rx fitted to the U1 is already setup correctly. It uses PWM on 2 channels and SBUS
- RX channel assignments:
  - Ch. 1 – Aileron/Roll,
  - Ch. 2 – Elevator/Pitch
  - Ch. 3 – Throttle
  - Ch. 4 – Rudder/Yaw
  - Ch. 5 – Mode Select (3 position switch)
  - Ch. 6 – Landing Gear (2 position Switch)
  - Ch. 7 – Flight Controller Switchover (2 Position Switch)
  - Ch. 8 – Parachute trigger
  - Ch. 9 – Velocity Lock (Slider, upcoming release)
  - Ch. 10 – Return to home (2 position switch)
- Channel's 1 thru 4 require end points to be set at 110%
- Subtrim
  - Ch.1 0
  - Ch.2 0
  - Ch.3 0
  - Ch.4 0
  - Ch.5 thru 10 0
- Switch assignments can be set by the user.
  - The mode select switch requires a 3 position switch.
    - One pulse width to 2.0ms, 100% End Point. (Loiter, Altitude hold)
    - Centre position to 1.5ms, Subtrim 0. (Stabilized Mode, Altitude Hold)
    - Final position to 1.0ms, 100% End Point. (Stabilized Mode, Manual throttle)
  - Landing Gear is a two position switch (+100/-100%)
  - Flight Controller Switchover also uses a two position switch. (+100/-100%)
  - RTH uses a two position switch (+100/-100%)
- If you do not have enough two position switches:
  - Fit a 2 position in place of a 3 position, or
  - Set up a 3 position switch so that two positions are the same
- Set the Landing Gear to Failsafe in the lowered position

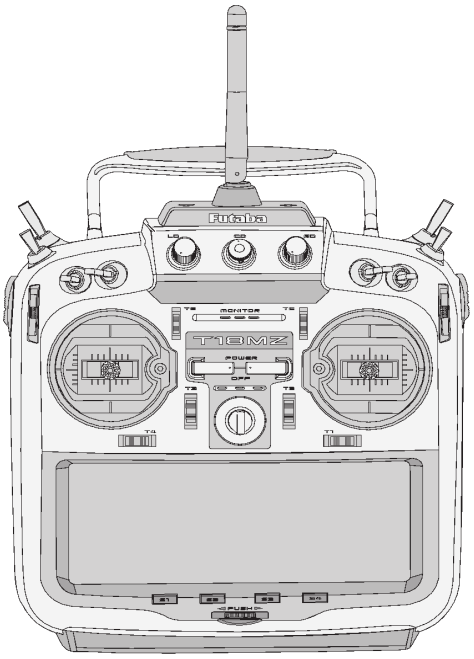
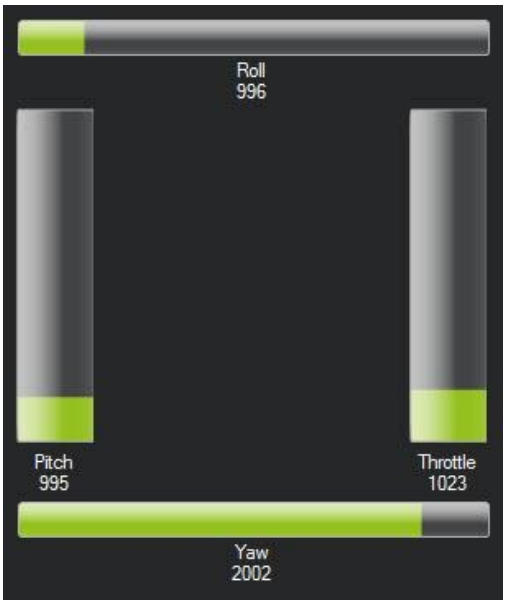


Figure 16

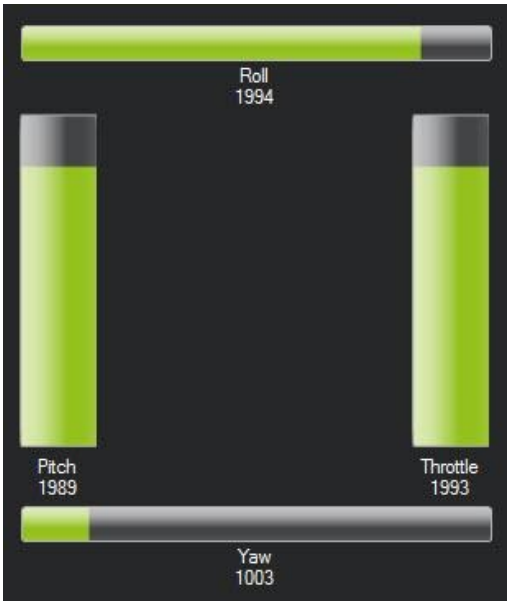
- Unplug the motor power wires at the arm junction. These can be identified as a pair of large gauge red and dark grey wires.
- Power on the Ground Station and U1.
- Once the link is established, open Mission Planner
- Power on the U1, and the Ground Station.
- Connect to Mission Planner on TCP, 57600
- In the IP address window enter the IP address of ‘U1-Multirotor’ as found in the network tab of the WebUI
- Port is 32000
- Go to Initial Setup, Mandatory hardware, Radio Calibration
- Select Calibrate Radio and follow the onscreen instructions

- Confirm the stick directions by comparing your system to the images below

Sticks Down and left: (roll left, pitch back, yaw left, throttle down)



Sticks Up and Right (roll right, pitch fwd, yaw right, throttle up)



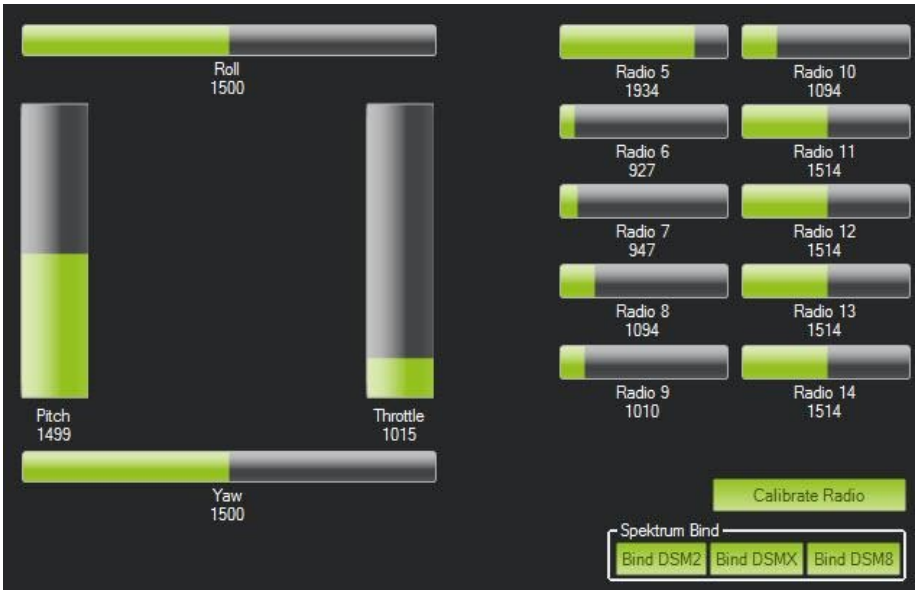
- Mode Switch
  Current flight mode (under Primary FCU) should also change to match the mode the system is currently in.

Stabilized Mode

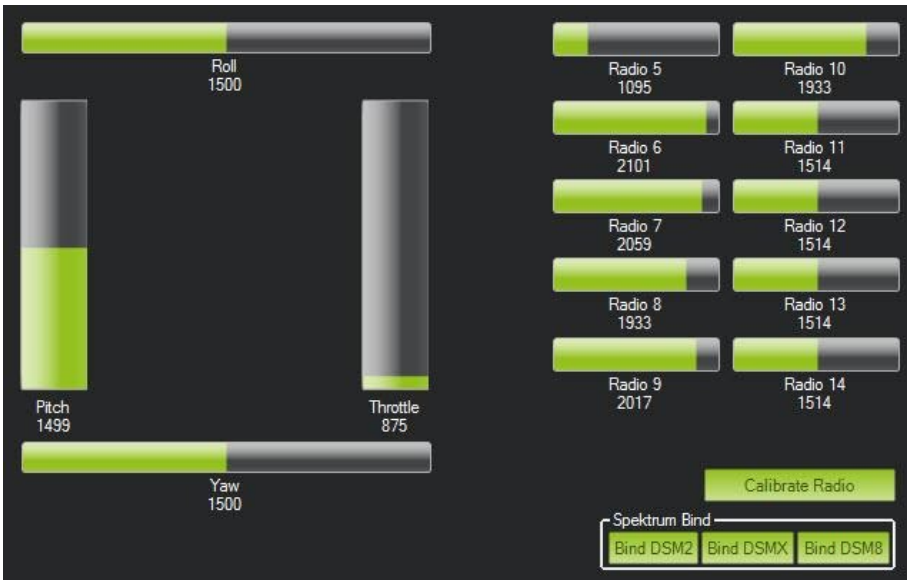
Altitude Hold

Loiter

- RTH, F/C switchover switched off, Landing gear gear down. Parachute safe (Ch 6 thru 10)



RTH, F/C switchover switched on, Landing gear up. Parachute fire (Ch 6 thru 10)



Compass

The U1 compass comes pre-calibrated. You do not need to recalibrate the compass for your location, or when your location changes. The Declination is set automatically so long as you have GPS reception. If you do not have GPS reception please change the declination as per below

Setting the Compass Declination:

1. Power on the U1, and the Ground Station.
2. Connect to Mission Planner on TCP, 57600
3. In the IP address window enter the IP address of the U1-Multirotor as found in the network tab of the WebUI
4. Port is 32000
5. Got to Mandatory Hardware, Compass
6. Set the declination for your current location.

The Flight Controller is reliant on a correct compass heading. Ensure the Declination is correct as part of the pre-flight checks.

7 Aerial Operation

Warning: When operating in warm weather please ensure the U1 and G1 are kept in the shade until ready to fly

Pre-Flight Checks

GPS/Compass	• GPS antenna upright and tight. • No additional items fitted to the top of the U1 (These will interfere with the compass).
Motor & mount	• Check torque on all motor fasteners. • Inspect the motor mount, to ensure there is no signs of cracking. • Check bearings for any play, and are running smoothly.
Propeller hub	• Visual inspection to ensure there is no signs of damage or cracking.
Propellers	• Check torque on propeller fasteners. Fasteners should be torqued to 0.68nm • Visual inspection, checking for any signs of damage, pitting (from impact with debris), delamination, or any carbon-fatigue. **WARNING**: This is critical when flying in high-debris environments, where sand/dirt will quickly deteriorate the surface integrity of the leading propeller edges.
Gimbal	• Gimbal is locked in place. • Payload is fitted and balanced correctly. • Ensure that the payload clamps are tight. • Inspect the drum clamp for any cracks. • Check torque on all bolts.
Overall	• Inspect all carbon fibre surfaces for signs of delamination, or crack propagation. • Ensure landing gear legs are tightly retained. • Ensure arm clamps are tight.
Electrical	• Ensure that all batteries are connected to both the main battery input, as well as the monitoring port. • Check all batteries are fully charged (Transmitter and Flight Packs). • Check all batteries are secured with battery straps. • Position lights are functional. • Ensure transmitter is bound to receiver.
Parachute (if fitted)	• Load straps are securely fitted to the arms. • Parachute housing is secured to the mounts. • Parachute assembly is plugged into the hub lid.
Automated Software Checks	• If no flags are raised during the check up until this point, once the U1 is powered on, an automated pre-flight check will be run by the U1's internal software, to ensure the U1 will perform as expected. Ensure the WebUI is not displaying any errors, and the position lights are not displaying the master alarm.
WebUI	• Ensure all power supplies are functioning. • Ensure both flight controllers are Ready to Arm • Check the Compass Declination is correct

Preparation for Flight

1. Carry out the pre-flight check. If any aspect of the pre-flight check fails, it must be rectified before take off.

2. Power up the ground station, accessories, and RC transmitter.
3. Connect fully charged batteries to the U1, and switch the system on.
4. The position LED's will start flashing slowly until the system is initialised.
   This will take 3-5 seconds on average. If it is the first time switching the U1 on in a new location, it will take up to 5mins to obtain the GPS connection.
   - If the self-check and initialisation is successful, the position lights will start flashing quickly. The ESC's will also chime, indicating that the ESC's are receiving signals from the flight controller.
   - If the system has not armed after 5mins, or the LED's flash rapidly, please refer to the WebUI.
5. You will now have gimbal control, camera image, and POV image.
6. The position lights will change to a fast flash once both flight controllers are initialised.
7. Ensure you have a clear view of the pilot monitor, to observe any warnings or errors.
8. If you wish to view Mission Planner while in flight:
   a) Download and Install Mission Planner from the SHOTOVER Portal.
   b) Power on the U1 and ground station ensuring the power leads to the motors in the arm joints are disconnected
   c) Once the link is up open Mission Planner
   d) Connect to Mission Planner on TCP, 57600
   e) In the IP address window enter the IP address of the "u1-multirotor" as found in the network tab of the WebUI
   f) Port is 32000
9. Move both transmitter sticks down and inwards, hold till the position lights turn solid, then release the sticks and increase the throttle to idle. The lights will remain solid.
   - If both flight controllers are armed, the position lights will turn solid and there will be no warnings on the pilot monitor.
   - If the lights are solid with a flash off every 1 to 2 secs then one of the flight controllers is not armed. This will generally be the secondary FC, and can be rectified by lowering the throttle, allowing the system to disarm, and then rearming the system.
10. Move both sticks down and out to disarm the flight controllers.

Warning: Do not drop the throttle to 0 during flight. The system will not stabilise at 0 throttle and if held for 5 seconds the system will disarm

Transitioning To Flight

1. Slowly increase the throttle, allowing the U1 to take-off.
2. Bring it to a hover, and ensure all stick orientations are correct, and the system is responding as you would expect.
3. Raise the landing gear, and fly. Monitor the WebUI and/or the pilot monitor while flying. If any warning or errors are displaye,d or something does not seem correct, land as soon as possible.

Flight Modes

Stabilized Mode

- This is stabilized on the roll, pitch, and yaw axis, with manual throttle control.
- It has a maximum bank limit of 40deg.
- Stabilized mode overrules all other modes. If you experience instability, or other problems in flight, switching to Stabilized Mode can make a difference.

Stabilized with Altitude Hold

- Stabilized on Roll, Pitch, and Yaw, with throttle mid stick, maintaining the current height.
- There is a 5% dead band around the centre of the throttle stick.

- If the throttle is advanced or decreased beyond this point, the U1 will climb/descend as per Attitude Mode.

Loiter

- This is a ‘hybrid’ mode.
- When the sticks are centred, the U1 will hold its current position in the sky using the GPS.
- If an input is given, the U1 will move in the desired direction. Release the sticks to maintain the new postion

  If the U1 loses GPS lock when operating in Loiter mode, the system will stop and attempt to hover over a fixed point. The WebUI and Overlay will display the ‘GPS failure’ error. The pilot must switch back to Attitude mode within 2min of the GPS position being lost, or the system will slowly descend and attempt to land without GPS.

Landing

- While landing in all modes is possible we always recommend landing in Stabilized mode. If you prefer to land in a mode other than Stabilized always ensure the throttle is at zero before switching to Stabilized and disarming the motors.

Return To Land

Return to Land (RTL) will engage automatically if the transmitter link is lost, or can be used to enable the system to autonomously return to the location it was powered on, and land unaided. When using this feature, ensure the system is powered on at its take off point. As soon as the system obtains a GPS lock it will save the current Latitude and Longitude values as its 'Home' point.
If RTL is activated, the U1 will stop, and climb to the altitude set in Mission Planner (default is 15m). It will then rotate to face home, and fly until it is above its home point. The U1 will descend to 5m, then hold and slowly descend until it is on the ground. The motors will keep spinning for approx. 5 seconds, until they switch off. Always lower the throttle to 0 once the system has landed.

Warning: The system may tip over if landing on uneven ground, in windy conditions, or once it is on the ground if the motors are allowed to continue spinning.

In order to use RTH the operator must:

1. Set the RTH switch on the transmitter to On.
2. The U1 will fly home.
3. If you wish to cancel RTH, set the RTH switch off, or change the Mode switch.

   Note: If RTH is cancelled using the mode switch, and the RTH switch remains on, when Altitude Hold or Position Hold is activated, the system will enter RTH and it will fly home. This is due to the RTH switch still being switched to the On position.

4. Upon landing, lower the throttle stick to 0, and set the mode switch to Stabilised Mode. This will kill the motors immediately if they haven't already shut down

Warning: If the system is on the ground, do not switch to Stabilised mode if the throttle is above 0. The system may respond to the throttle stick and take off suddenly.

If you require a RTH height other than the default 15m:

1. Power on the U1, and the Ground Station.
2. Connect to Mission Planner on TCP, 57600
3. In the IP address window enter the IP address of the U1-Multirotor as found in the network tab of the WebUI
4. Port is 32000
5. Got to Config/Tuning, Advanced parameter list. Search for RTL_ALT.
6. Change the figure in RTL_ALT to the required altitude in cm's
7. Click 'Write Params', the setting will be saved in the Flight Controller.
8. Disconnect from Mission Planner.

Flight Controller Switchover

The flight controller switchover allows the pilot to switch to the secondary flight controller in case of an error with the Primary flight controller. It is for emergency use only. If the secondary flight controller is selected, the system must be landed as soon as possible.

Warning: It is not possible to switch back to the primary flight controller

The secondary controller is stabilised, with manual throttle. There is no Altitude hold, Position hold, or any other pilot aids available, including Return To Home. This includes transmitter loss fail-safes.

When switching, the following may occur:

- At a slow speed there may be small movement in pitch, roll and yaw.
- At high speeds the system will switch, and the pilot will be required to control the U1 and bring it into a hover. During a high speed switch there can be a small offset occur in pitch, a small amount of constant pitch input may be required to maintain a hover. A power cycle will be required to reset the system and renable the primary flight controller.

Inflight Warnings

If there is a fault in flight, there are three methods of warning the pilot and gimbal operator:

1. Visually, in flight with the position lights flashing fast.
2. Visually, on the Pilots and Gimbal operators monitors.
3. Visually within the WebUI.

If any Inflight warnings are displayed, land the U1 immediately.

Refer to Appendix C, Fault Finding to determine the fault, and how to rectify it.

Warnings	**Critical Warnings**
Shown by an Overlay Message, and highlighted in the WebUI. ● Batt Voltage Low – also vibration through Tx ● GPS failure ● ESC Over temp ● Power Distribution Board Over Temp ● High current use ● Secondary FC Active	Shown by an Overlay Message, Flashing Position lights and highlighted in the WebUI. ● Batt Voltage Very Low – also vibration through Tx ● 12v Essential failure ● ESC critical temp ● Gimbal Power failure ● Non-Essential Power supply failure ● Battery String failure (redundancy activated) ● Flight Controller error ● Secondary FC not armed

Warning limits

Overlay message	Warning limits	Critical Limits	Normal range	Description
Batt Warning / Critical	42 – 43.5 V	0-42 V	>43.5 V	Main flight pack voltage
Arm Temp Warning / Critical	85-100°C	>100°C	<85°C	Motor/ESC assembly overheat
12V Ess Warning / Critical	11-11.5 V	0-11v	>11.5 V	12V #1 or 12V #2 power supply failure
5V Supp Warning / Critical	4.5-4.9v	0-4.5 V	>4.9 V	5V Power supply failure
Power1(or2) Temp Warning / Critical	85-100°C	>100°C	<85°C	Power Distribution Board temperature
Prm FC Error				Error in the primary flight controller. Land and Investigate
Prm FC comms error/timeout				Communication between the primary flight controller, and the U1 Brain has been interrupted
Sec FC Comms error/timeout				Communication between the Secondary FC and the U1 Brain has been interrupted
Battery1 Cutoff				Battery string 1 has been disabled
Battery2 Cutoff				Battery string 2 has been disabled

User Configurable Settings

The following Cube FC settings can be safely adjusted within Mission Planner.

- Connect to Mission Planner.
- Go to the Config/tuning tab, Advanced Params.
- Type in the ID below and set it to the required value
- Select 'Write Params'

Warning: Ensure the values you enter are correct and verify the units before writing the parameters.

RTL

RTL_ALT: The minimum altitude the copter will move to before returning to launch.

- Set to zero to return at the current altitude.
- The return altitude can be set from 1 to 8000 centimeters.
- The default return altitude Default is 15 meters (1500)

WP_YAW_BEHAVIOR: Sets how the autopilot controls the "Yaw" during Missions and RTL.

- 0 = Never change Yaw.
- 1 = Face Next Waypoint including facing home during RTL.
- 2 = Face Next Waypoint except for RTL (i.e. during RTL vehicle will remain pointed at it's last heading)

ALT HOLD

PILOT_VELZ_MAX : Climb/Descent Rate.

- Outside of the mid-throttle deadzone (i.e. below 40% or above 60%) the vehicle will descend or climb depending upon the deflection of the stick. When the stick is completely down the copter will descend at 2.5m/s and if at the very top it will climb by 2.5m/s.

THR_DZ : Throttle stick deadband.

- The size of the deadband can be adjusted with the THR_DZ parameter. This param value should be between "0" and "400" with "0" meaning no deadband. "100" would produce a deadband 10% above and below mid throttle (i.e. deadband extends from 40% to 60% throttle stick position).

LOITER

WPNAV_LOIT_SPEED : max horizontal speed in cm/s.

- I.e. 500 = 5m/s. By default, the maximum acceleration is 1/2 of the Loiter speed (i.e. 2.5m/s/s).

8 Maintenance

Operator Responsibilities

The U1 Maintenance Manager / Controller must ensure that the maintenance requirements as detailed in this Maintenance Program, are complied with, and is responsible for:

- The accomplishment of the maintenance prescribed in the program.
- Continuity of the program.
- Compilation and retention of records, reports, and technical reference material.

General Maintenance Standards

Practices and procedures necessary to accomplish the requirements of this schedule, or work resulting from its application, should be, as a minimum, to the standards contained in the relevant instructions for continued airworthiness; and, where applicable, the [relevant country] Civil Aviation Authority (CAA) advisory circulars.

Service Information

Service information (which includes service documents such as service bulletins, service information letters, as supplied by the unmanned aircraft manufacturer etc.) will be formally technically assessed, and the outcome documented by the Maintenance Controller.

Where the adoption of the service information impacts on the maintenance of the aircraft, this program must be amended.

Compliance with implemented service information must be recorded in the appropriate maintenance logbook.

Repairs or Modifications

Repairs or modifications which have been carried out to the aircraft, motors, propeller, components, or radio after original manufacture, must be recorded in the appropriate maintenance log book.

Scheduled Inspection Checklists and Worksheets shall be amended to include the additional ICA instructions.

Records

Maintenance performed is to be recorded in an aircraft logbook. In addition, work packages compiled and/or worksheets as raised by the maintenance contractor form part of the aircraft's maintenance records, and are to be retained by the operator.

Scheduling Maintenance

The Maintenance Controller will check the aircraft technical log and maintenance logbooks to determine the scope of each scheduled inspection as it arises.

They will also ensure a work package for the inspection is raised. Attention shall be paid to verifying the currency of the data in use: e.g. Service/Owner manual revision, as well as any latest maintenance information.

Inspection Cycle

The maintenance of the U1 will be heavily dependent on visual interrogation, in the forms of Pre-Flight, and daily inspections.

These inspections are designed to rectify any detectable flaw in the U1, before flight operations begin. In addition to these regular visual inspections, the operator will monitor the hours of different components of the U1 that have specific lifetimes, such as Propellers and Motors, replacing components after the time, or wear thresholds are met.

This monitoring and replacing of components will be followed by a full covers-off inspection after every 10 hours of operation, to search for and replace failing components. The combination of these staggered inspections and maintenance procedures, should ensure the safe operation and performance of the U1 system.

Daily Inspection

This inspection is a primarily visual inspection, to ensure any detectable problem with the U1 is rectified before flight. This inspection is to be carried out daily, in addition to any other Pre-Flight checks, or servicing requirements.

U1 Multirotor	• Remove the hub lid, and perform a detailed visual inspection of the internal mechanics and electronics. • Perform an extensive visual inspection of all carbon fibre surfaces, checking for signs of delamination or crack propagation. • Inspect Propellers for signs of pitting, delamination or any carbon fatigue. • Inspect Propeller Hubs for any signs of damage or fatigue. • Check Antennas are all attached securely, and undamaged. • Inspect motor mounts for any cracks, and/or lose fasteners. • Check torque on all fasteners. • Check that the landing gear is functioning correctly. • Inspect the mechanism, legs and feet of the landing gear. • Inspect the isolators for any signs of damage. • Inspect the motor bearings etc.
G1 Gimbal	• Inspect bearing play. • Inspect any carbon fibre surfaces for signs of delamination, and/or crack propagation. • Check torque on all fasteners.

Covers-Off Inspection

The 'Covers-Off' inspection is to be carried out every 10 hours of operation, approximately every 30 flights. This inspection represents the most intense level of inspection that the U1 will undergo in its inspection cycle, involving a detailed check of internal components, and electrical systems.

- Check the circuit board is secured firmly, and all fasteners are tight.
- Check all visible wiring for signs of overheating/shorts.
- Check the flight controller is secure .
- Check the RF link is secured firmly, and all fasteners are tight.
- Check all connectors are secure.

Lifed Components

Item	Period	Action
Batteries	At any sign of degradation i.e. swelling in the pack, reduced flight time.	Replace all
Propellers (KDE)	25hrs or at any signs of damage, pitting (from impact with debris), delamination, or any carbon-fatigue.	Replace all
Propellers (T Motor)	As required or at any signs of damage, pitting (from impact with debris), delamination, or carbon-fatigue.	Replace all
Propeller Hub (KDE)	25hrs or at any sign of fatigue, damage or corrosion.	Replace all
Propeller Hub (T Motor)	At any sign of fatigue, damage or corrosion.	Replace all
Propeller Bolt	15hrs or at any sign of fatigue, damage or corrosion.	Replace all
Motor Bearings	200Hrs, in the event of a crash or at any sign of bearing rumble in the motor. *Note: A few flights in a high sand/saline environment will significantly shorten the lifespan of the bearings.	Replace
Motor Shafts	400 Hrs or upon any sign of fretting/abnormal wear between the bearings and shaft interfaces, seen during routine bearing maintenance.	Replace
Landing Gear Servo Motor	Upon any sign deterioration in performance .	Replace

Parachute Pyrotechnic	5 years from manufacture or after 25hours flight time.	Replace
Parachute	Repack/check 6 monthly or 25 hours flight time.	Repack

Fitted Equipment Requirements

Item	Periods	Standard
Include mods/fitted equipment etc.	Instructions of continued airworthiness	ICA requirements
Recovery Parachute (optional)	Repack every 6 months and after use if undamaged	See Galaxy Sky GBS 10/350 data sheet http://www.galaxysky.cz/technical-data-s26-en
Gimbal	Check it is secure each flight, comply with Gimbal maintenance at all times.	See Pre-Flight and Daily Inspections

9 Web User Interface (WebUI)

All Tuning, upgrades, and configurations are carried out via the SHOTOVER Web User interface (WebUI).

Multiple devices can be used at the same time. Ensure browsers are refreshed often, as not to see values changed by another browser.

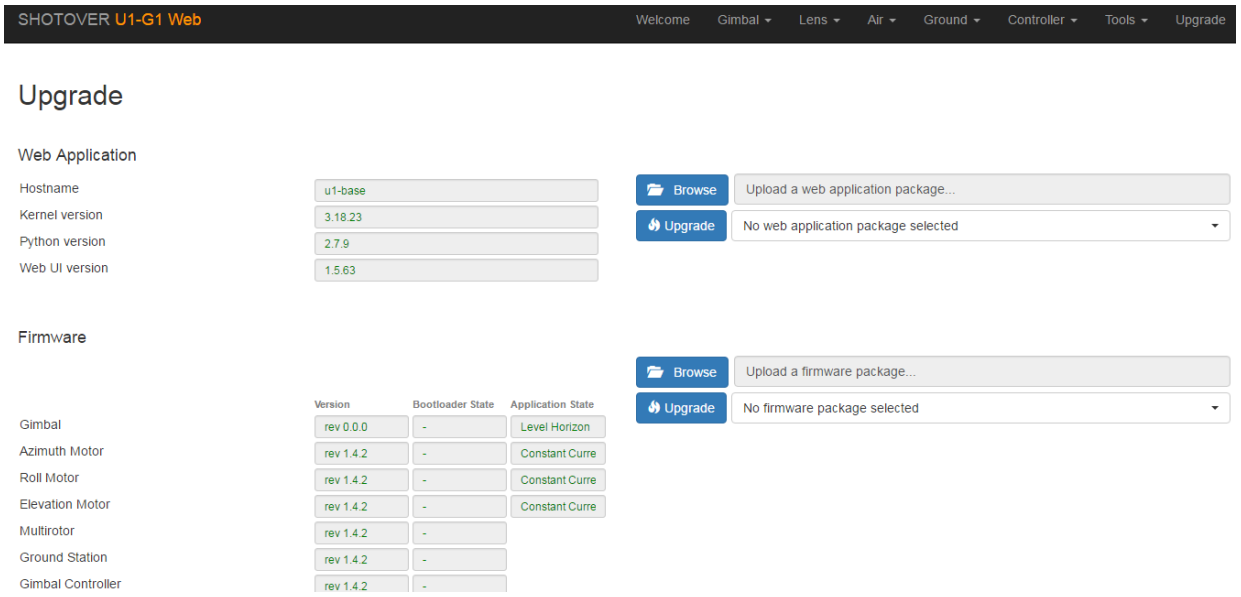
To utilise this interface, proceed as follows:

1. Switch on PC or mobile device being used.
2. Ensure the arms are disconnected from the hub, or the props are removed.
3. Plug two 6s batteries into the U1 – ensure they are on opposing sides of the hub, this is one battery string. (See section 4 > Battery Redundancy)
4. Switch on the G1 system. Follow the instructions in the G1 owner's manual.
5. On the PC or mobile device, disconnect from any wireless networks.
6. Search for Shotover G1 (relevant serial #)
   e.g. Shotover G1 001
7. Connect to this wireless network.
   Password is **shotover**
8. Open Browser and type IP address 172.20.1.1

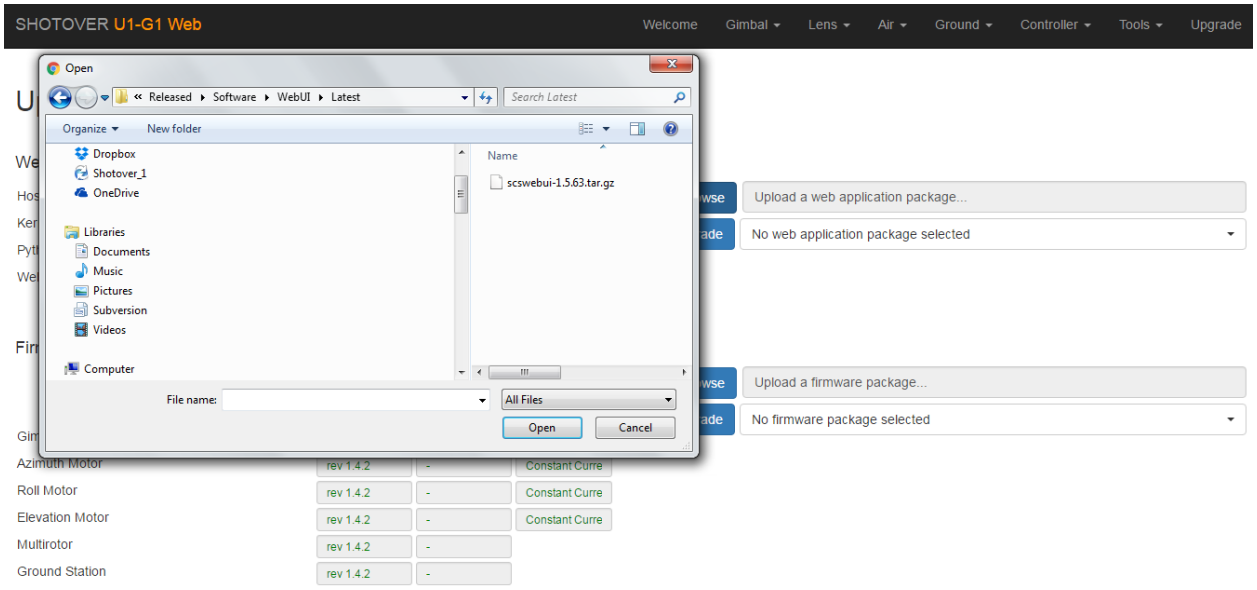
Please note, that depending on your device settings, your device might disconnect from this network as it does not have an internet connection. Therefore, the device might switch to a known wireless connection with internet.

Web UI Upgrade

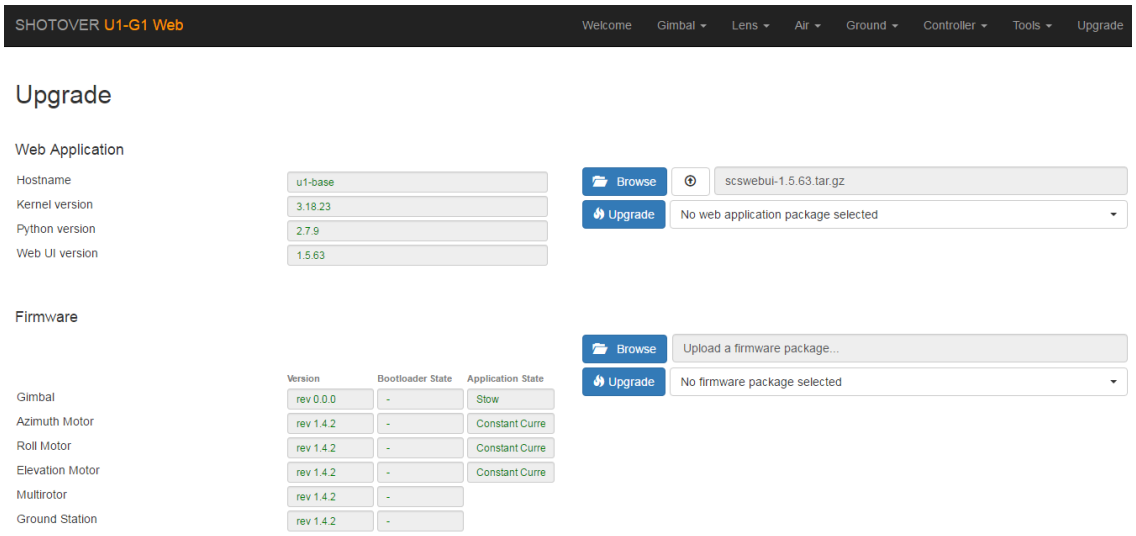
- To upgrade the Web UI, select upgrade from the Web UI navigation bar.



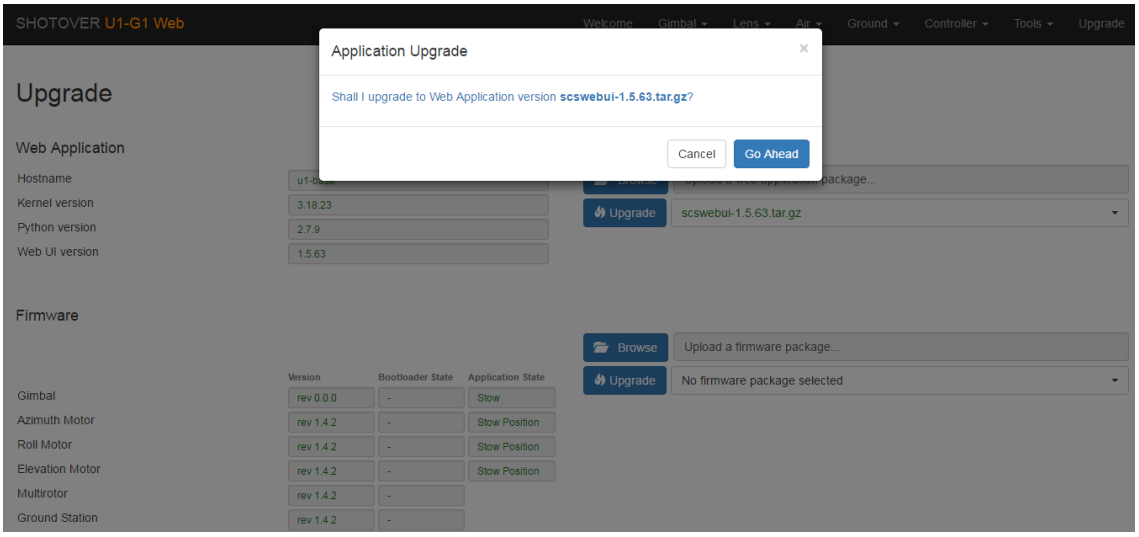
- Click Browse and find the required file. Latest firmware is available at: www.SHOTOVER.com



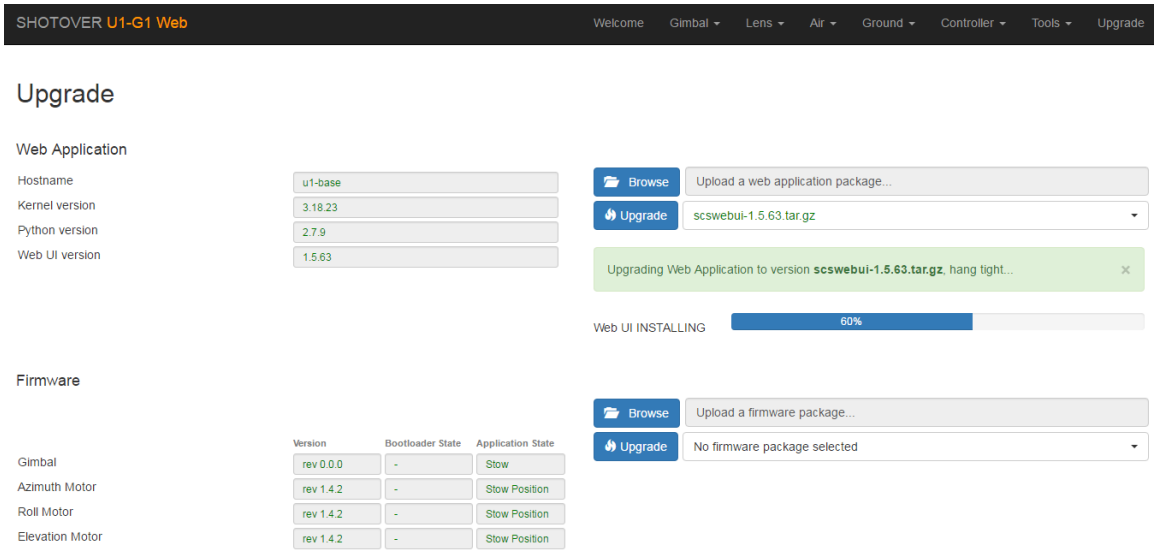
- Click the upload arrow, and wait for the file to upload completely.



- Select the correct file from the drop-down menu next to the Web UI upgrade button.
- Press the upgrade button, and click go ahead when the pop up asks for permission.

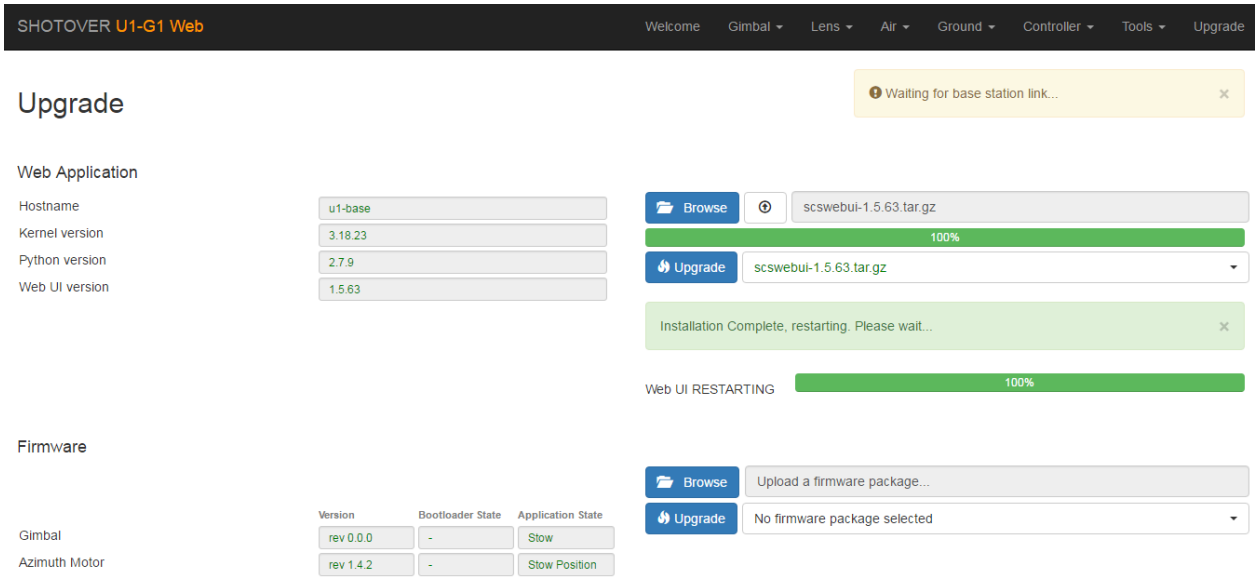


- While upgrading, the message below will appear.



- When the upgrade is complete, the message below will appear. Refresh the browser (F5). Ensure the

correct version is displayed in the Web UI version box.

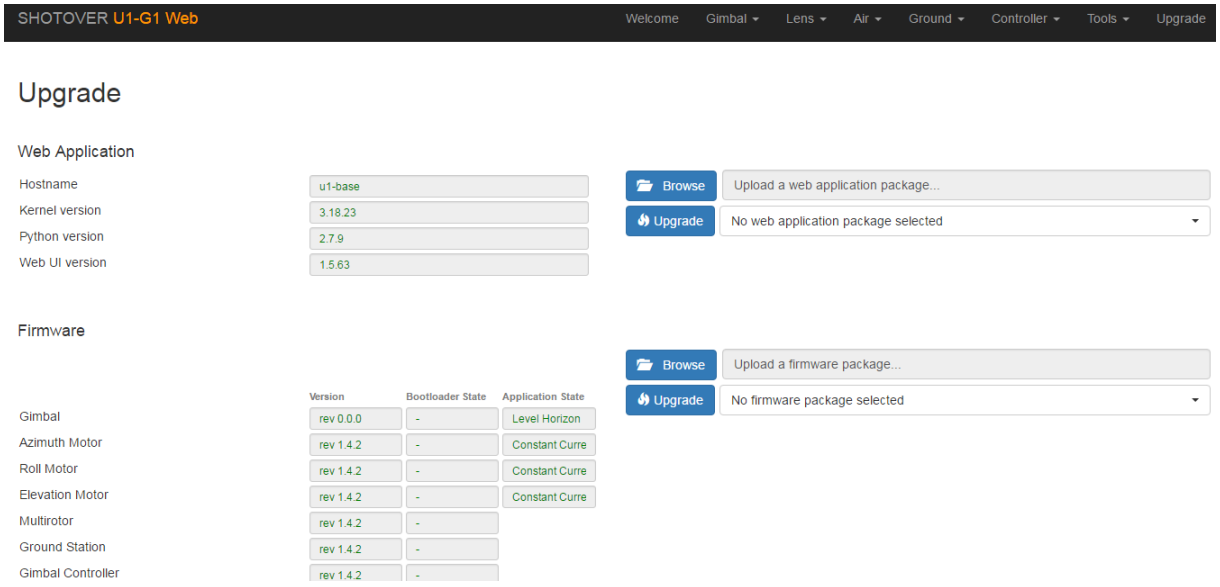


Firmware Upgrade

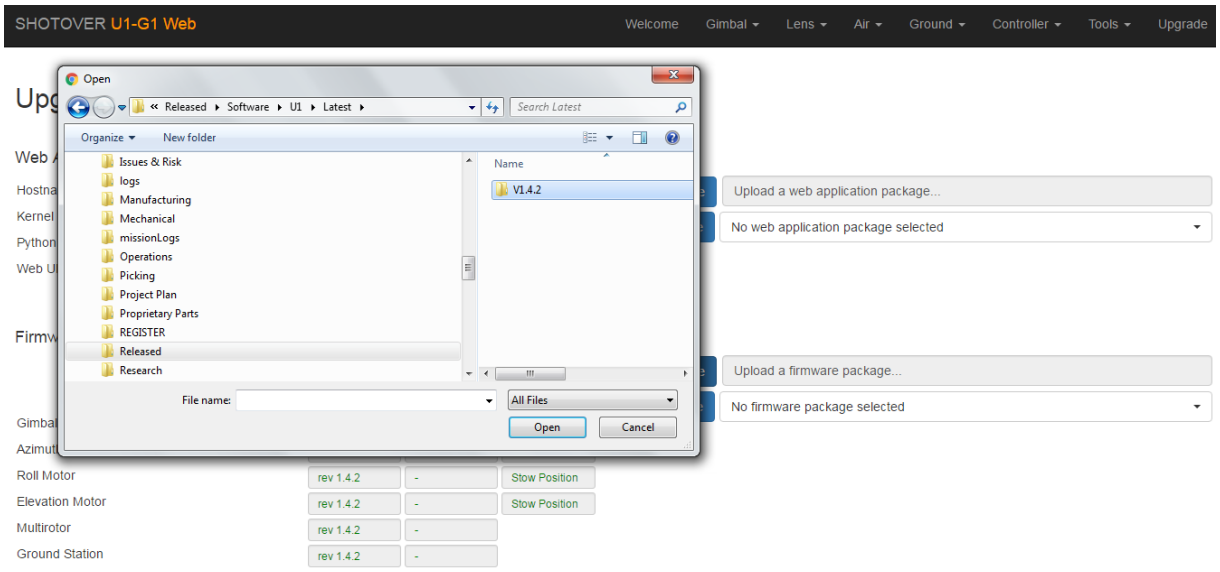
Firmware upgrading is carried out through the SHOTOVER WEB user interface (WebUI).

Warning: Always disconnect the power leads to the motors at the arm joints when carrying out firmware or Flight Controller upgrades.

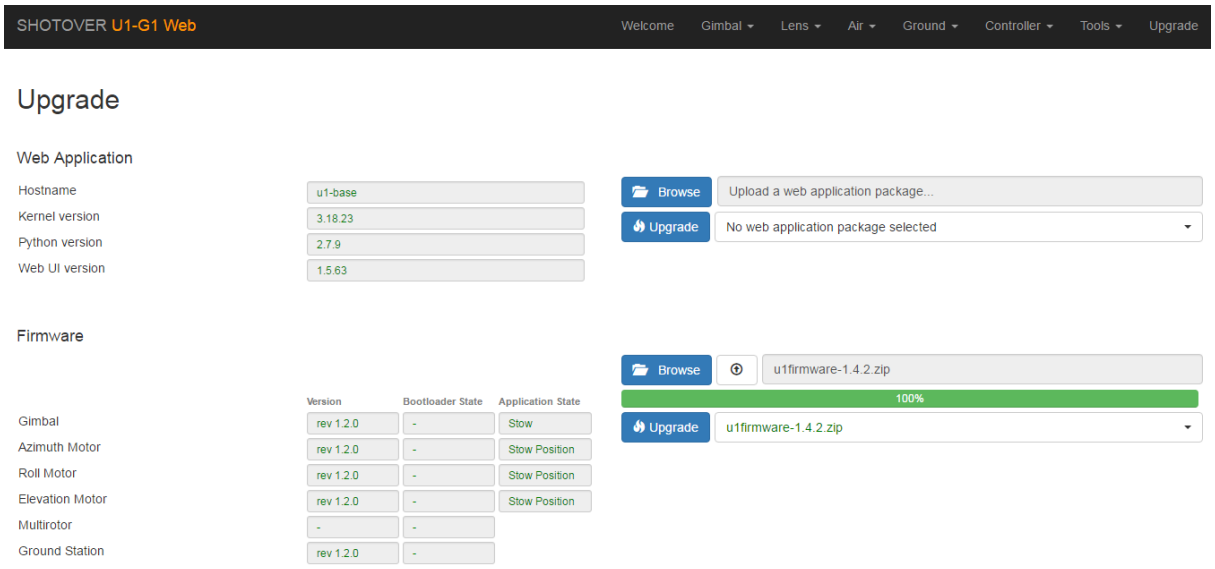
- Turn the U1 system on, as per section 6.
- Connect PC to the SHOTOVER WEB user interface as described at the start of section 10.
- Select the upgrade page in navigation bar.



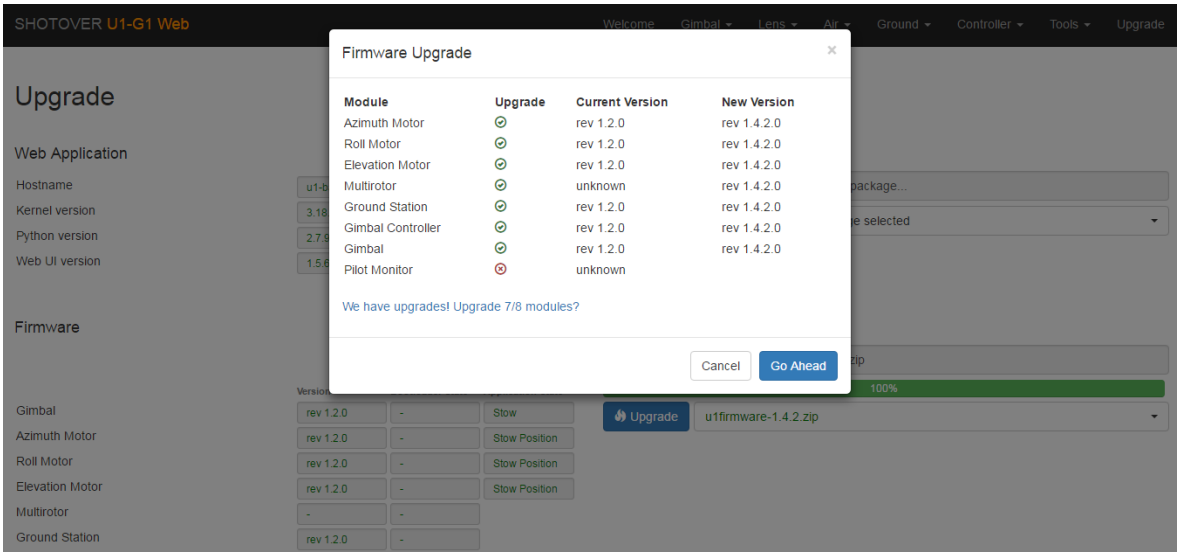
- Select Browse and search for the correct version firmware. It will be a .zip file. Latest firmware is available at: www.SHOTOVER.com


SHOTOVER U1-G1 Web
Welcome
Gimbal
Lens
Air
Ground
Controller
Tools
Upgrade
Open
Released
Software
U1
Latest
Search Latest
Organize
New folder
Issues & Risk
logs
Manufacturing
Mechanical
missionLogs
Operations
Picking
Project Plan
Proprietary Parts
REGISTER
Released
Research
Name
V1.4.2
File name:
All Files
Open
Cancel
Upload a web application package...
No web application package selected
Upload a firmware package...
No firmware package selected
Roll Motor
Elevation Motor
Multirotor
Ground Station
rev 1.4.2
Stow Position

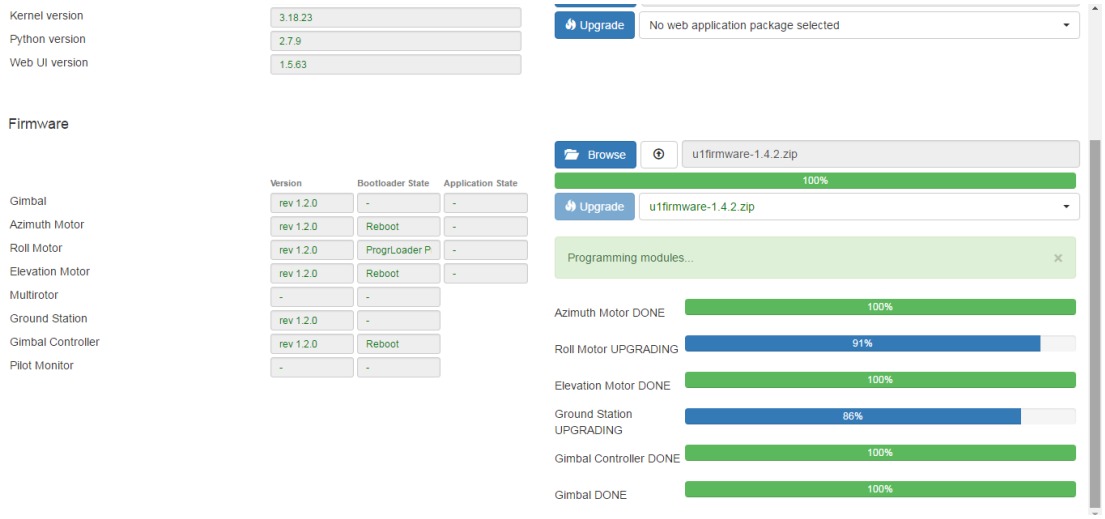
- Click upload arrow, and wait for the file to upload completely.



- Select the correct file from the drop-down menu next to the Firmware upgrade button.
  Press the upgrade button, and click go ahead when the pop up asks for permission.



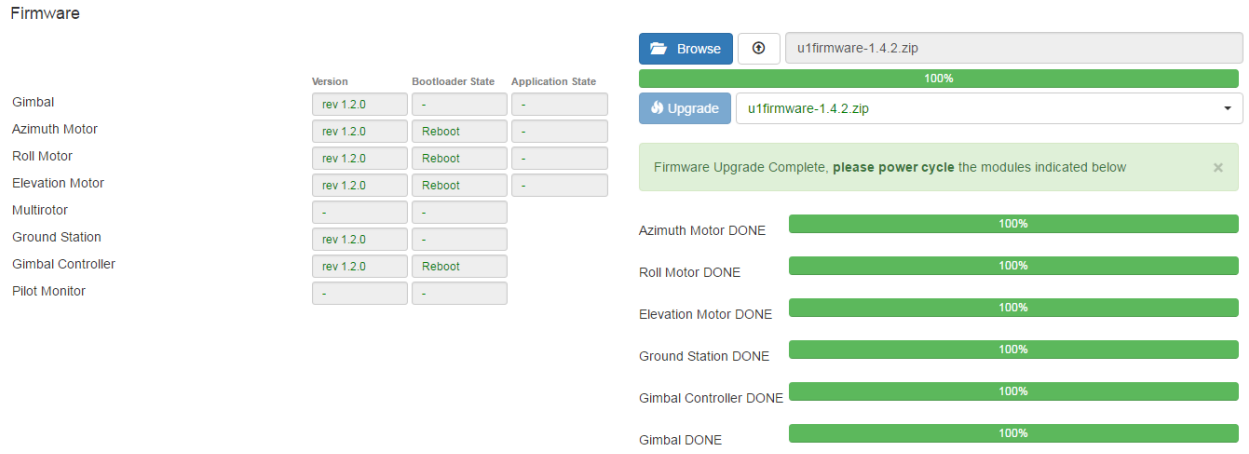
- While upgrading, the message below will appear. The system will enter boot mode.



- Once the upgrade has completed a system reboot is required. To do this just cycle power on the U1 and

ground station if required.

- If upgrading from a very old firmware version, new boot loaders may be upgraded too, this will require 2 power cycles as bootloaders will upgrade on the first, and application software on the second.



The Cube Firmware Upgrade

Warning: Always disconnect the power leads to the motors at the arm joints when carrying out firmware or Flight Controller upgrades.

1. Download and Install Mission Planner from the SHOTOVER Portal.
2. Power on the U1 and ground station ensuring the power leads to the motors in the arm joints are disconnected
3. Once the link is up open Mission Planner
4. Connect to Mission Planner on TCP, 57600
5. In the IP address window enter the IP address of the “u1-multirotor” as found in the network tab of the WebUI
6. Port is 32000
7. Go to Config/tuning, ‘Full Parameter List’
8. Select ‘Save to file’. Save the file as U1 Parameters PreUpgrade.
9. Select ‘Disconnect’ once the file is saved
10. Select Initial setup, Install firmware
11. Select the X8 Icon as shown (note: the number shown may differ from what appears below)

12. The firmware will upgrade, when completed a box will appear mentioning ‘musical tones’, wait 1 min from when this box appears then press ok. (there will be no musical tones heard)
13. Connect to Mission Planner on TCP, 57600
14. In the IP address window enter the IP address of the “U1-Multirotor” as found in the network tab of the WebUI
15. Port is 32000
16. Go to Config/tuning, ‘Full Parameter List’
17. Select ‘Load from file’ and select the previously saved parameter file.
18. Select ‘Write Params’

Pixhawk Firmware Upgrade

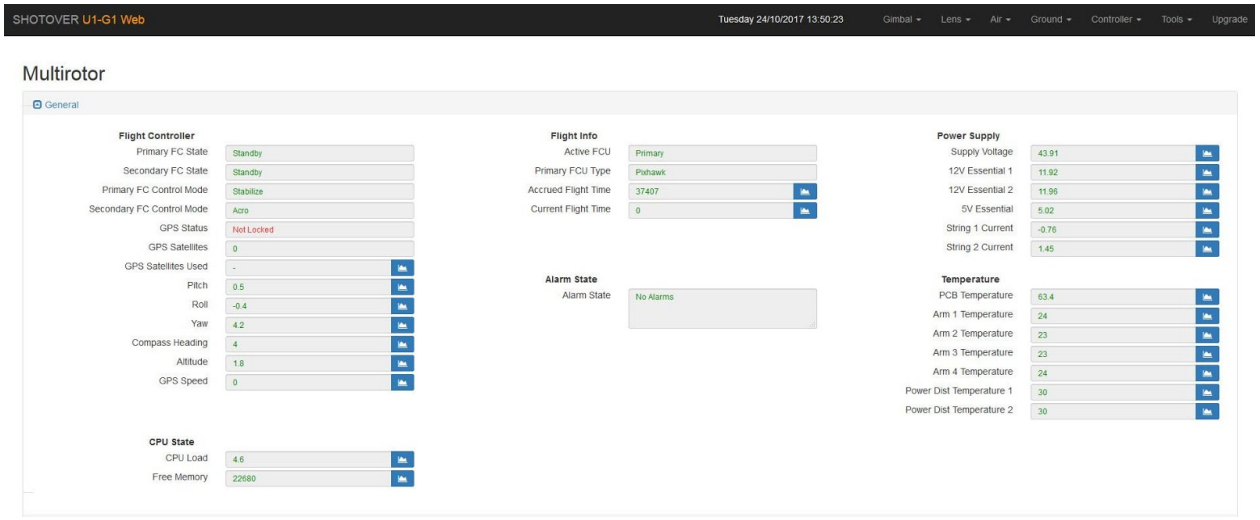
The Pixhawk must only use firmware supplied by SHOTOVER. Any attempt to run standard firmware will render the switchover inoperable.

1. Download and Install Mission Planner from the SHOTOVER Portal.
2. Download the Pixhawk Firmware file.
3. Plug in a Micro USB cable to the Pixhawk. The connector is at the inside edge of the Pixhawk at about the centre of the brain board.
4. Select the ComPort in the top right corner and set it to 115200.
5. Press ‘Connect’
6. Go to the Config/tuning tab. Select the ‘Full Parameter List’
7. Select ‘Save to file’ in the top Right corner.
8. Once the file has been, saved press ‘Disconnect’ in the top right corner
9. Go to the ‘Initial Setup’ tab, Install Firmware.
10. Select ‘Load Custom Firmware’ at the bottom of the screen.
11. Select the current Pixhawk firmware file downloaded from the SHOTOVER Portal, the upgrade will commence.
12. Mission Planner will mention musical tones. Watch the Large LED on the Pixhawk instead. Once this LED starts flashing blue, the upgrade is complete.
13. Connect to Mission Planner.
14. Go to the Config/tuning tab. Select the ‘Full Parameter List’
15. Select ‘Load from file’ in the top right corner. Select the supplied parameter file.
16. The Pixhawk upgrade is now complete.

Multirotor Air Tab

The Air tab displays information relevant to the Multirotor. All the information displayed here is recorded in the datalogger on board the ground station.
If there are faults within the system, they will be highlighted with a red cross.

- **General Tab**



- **Flight Controller**
  - Primary FC State – Displays the status of the primary flight controller.
  - Secondary FC State - Displays the status of the secondary flight controller.
  - Primary FC Control mode – Displays the current mode of the Primary FC
  - Secondary FC Control Mode - Displays the current mode of the Secondary FC
  - GPS Status – Locked or not Locked.
  - GPS Satellites – Shows the number of Satellites currently available
  - GPS Satellites Used – Shows the number of Satellites currently used
  - Pitch – Current Pitch of the U1 (degrees).
  - Roll – Current Roll of the U1 (degrees).
  - Yaw – Current Yaw of the U1(degrees).
  - Compass Heading – Current compass heading (degrees).
  - Altitude – Current Altitude in feet.
  - GPS Speed – Speed over ground in feet per second.

- **Flight Info**
  - Active FCU – The current flight controller that has control of the U1. This will display Primary or Secondary.
  - Primary FCU type – Cube or Micropilot
  - Accrued Flight Time – Total accrued flight time of the system since it was built. This will increase after the motors are disarmed post flight (seconds).
  - Current Flight Time – The timer starts when the motors are armed and stops when they are disarmed (seconds).

- **System State**
  - CPU Load – Load on the Brain board CPU.
  - Free Memory – The amount of memory available on the Brain

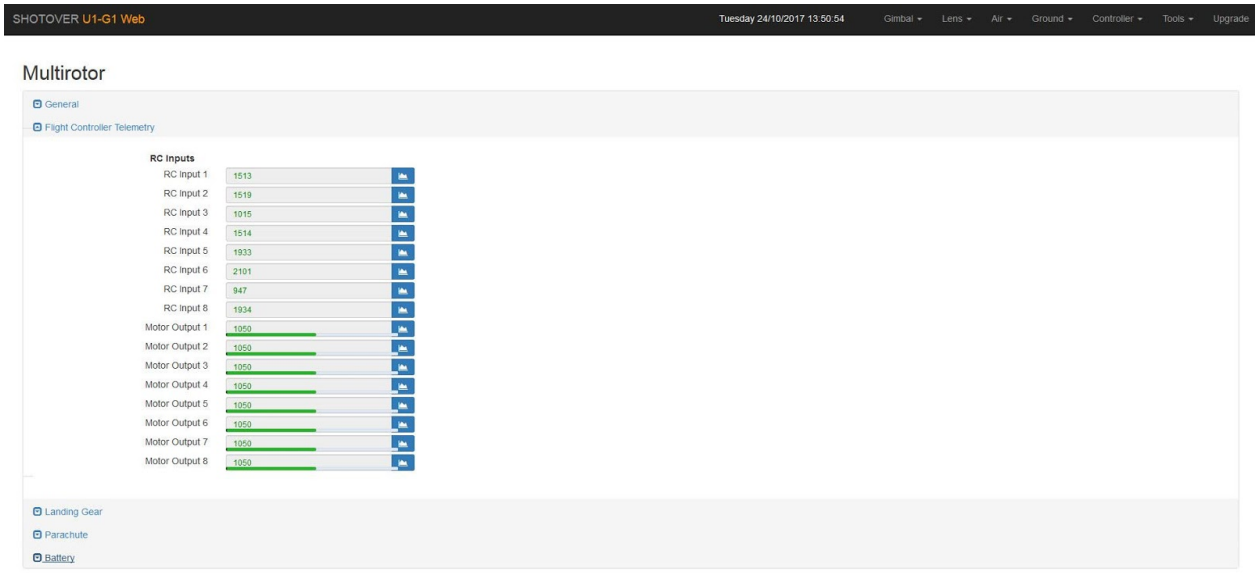
- **Alarm State**
  - Alarm State – Summary of all current critical hardware alarms.

- Landing Gear State - User Control In Flight; Auto Extend Secondary FCU Selected or Bus Voltage Fault, Battery String One Current Fault, Battery String Two Current Fault, Return Home Active, RC lost.
- Battery State – Displays which battery strings are connected. This will show String One and Two connected for 2 sets of batteries, or a single String One (or Two) if only one set is plugged in.
- Parachute State – Fitted or Not Fitted.

- **Power Supply**
  - Supply Voltage – Current Voltage of the flight packs.
  - 12v Essential 1 – Voltage of the first essential 12v power supply. This should always read 11.8v or above.
  - 12v Essential 2 – Voltage of the second essential 12v power supply. This should always read 11.8v or above.
  - 5v Essential - Voltage of the 5v power supply. This should always read 4.8v or above.
  - String 1 Current – The current being pulled from Battery String 1 (amps).
  - String 2 Current – The current being pulled from Battery String 2 (amps).

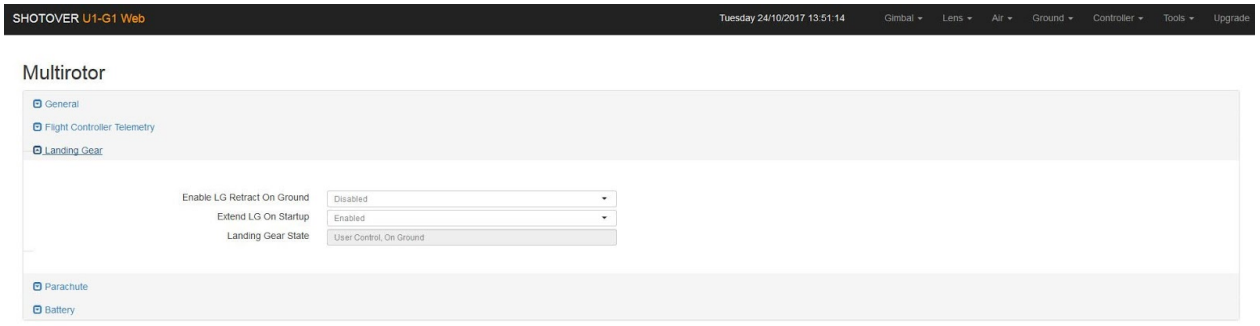
- **Temperature**
  - PCB Temperature – Current temperature of the Brain Board inside the U1.
  - ESC1 Temperature – Temperature of the ESC/motor assy in Arm1 (deg C).
  - ESC2 Temperature – Temperature of the ESC/motor assy in Arm2 (deg C).
  - ESC3 Temperature – Temperature of the ESC/motor assy in Arm3 (deg C).
  - ESC4 Temperature – Temperature of the ESC/motor assy in Arm4 (deg C).
  - Power Dist Temperature 1 – Temperature of the Power Distribution board within battery String 1 (deg C).
  - Power Dist Temperature 2 – Temperature of the Power Distribution board within battery String 1 (deg C).

- **Flight Controller Telemetry tab**



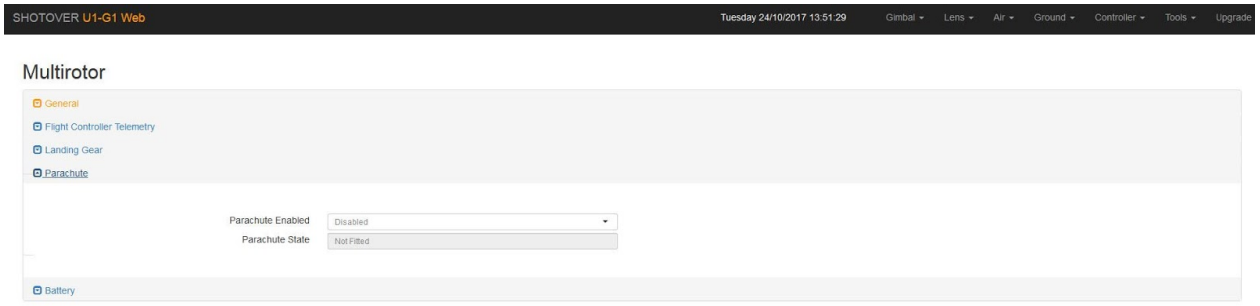
  - **RC Inputs**
    - RC Input 1 thru 8 – Shows the Rc inputs from the RC transmitter
    - Motor Output 1 thru 8 – Shows the output of the Flight controller to the ESC's (%).

- **Landing Gear**



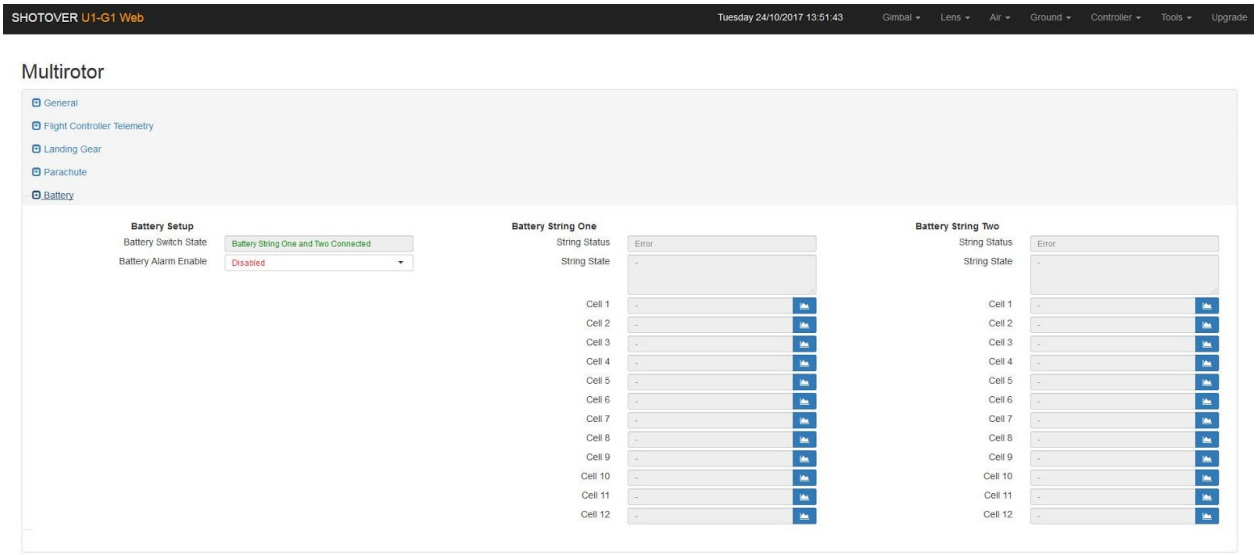
  - Enable LG Retract on Ground – Prevents the landing gear retracting while the system is on the ground. As soon as the system is in the air the gear can be retracted. Enabled or Disabled can be selected.
  - Extend LG On Start-up – Allows the landing gear to extend on start-up if retracted. Enabled or Disabled can be selected.
  - Landing gear State – Shows the current state of the landing gear.

- **Parachute**



- Parachute Enabled – Enables the parachute if fitted.
- Parachute State – The surrent state of the Parachute

- **Battery**



- **Battery Setup**
  - Battery Alarm Enable – Allows the battery monitoring to be disabled if required ie; a fault develops that does not threaten flight safety.
- **Battery String One**
  - String Status – Shows whether the string is connected, has errors, or has been disabled.
  - String State –
  - Cell 1 thru 12 – The voltage of each independent cell in the battery string (Volts).
- **Battery String Two**
  - String Status – Shows whether the string is connected, has errors, or has been disabled.
  - String State –
  - Cell 1 thru 12 – The voltage of each independent cell in the battery string (Volts).

10 Parachute (optional)

Warning: Utilisation of a parachute as a safety device does not guarantee a safe landing, and may not prevent damage to the aircraft or other property, and may not prevent harm to others. Wind, aircraft weight, aircraft orientation, and forward speed can all adversely affect the successful deployment and effectiveness of the parachute. When correctly fitted and successfully deployed, the parachute will limit the descent rate of the aircraft, and is intended to reduce the chance of injury or major damage to the UAV system. SHOTOVER gives no warranty as to the performance of the parachute. SHOTOVER is not liable for any damage or injury resulting directly or indirectly from the use of the parachute. If purchased the parachute setup will be completed by a SHOTOVER support centre.

Caution:

- The parachute is safe for use in systems up to 35kg AUW.
- The parachute will not deploy when triggered if:
  - The system is climbing.
  - The shorting fuse is fitted.
  - The secondary flight controller is not armed.
- If the parachute is not fitted, ensure the CH8 switch is inhibited in the transmitter, to prevent accidental triggering. If this is not inhibited, and the switch is triggered, the secondary flight controller will still attempt to fire the chute and shut off the motors, although the U1 will remain flying on the primary controller, as it will not switch to the secondary controller.

- **Sequence of Events**

  In the event of a parachute deployment the secondary flight controller is in control. When the command is received from the pilot to trigger the chute, the secondary FC will initiate the firing of the chute, the Multirotor brain will receive a signal from the Parachute that it has fired, the motors are shut off and the landing gear is lowered.

- **Setup**

  The parachute will be initially setup by a SHOTOVER support centre.
  - Setup Ch8 to trigger the chute in the RC transmitter. End-points should be set to 100% and Subtrim to 0.
  - Enable the parachute in the Air tab of the WebUI.

If the parachute is not fitted for some flights, ensure the transmitter is changed so that ch8 is disabled, and the parachute is disabled in the WEBUI. Failing to do so can cause the chute to be triggered if the switch is inadvertently activated.

- **Fitting**
  - Fit the parachute housing into the electronics housing, and tighten the clamp.
  - Secure the assembly onto the U1, using the 4 x m3 screws. The lights should face the status lights on the hub lid.
  - Fasten the lanyards from the chute to each of the 4 arms as shown.

Figure 17

- Fasten the remaining end of the 4 lanyards to the 2 D shackles attached to the Chute. Using the O-rings on the lanyards, tidy the lanyards to keep them from getting tangled.

Figure 18

- Hold the main parachute strap and lanyards in place against the chute housing using the large O-Ring as shown.

Figure 19

- Ensure the shorting fuse is installed, then fit the Pyrotechnic (if not already fitted), and follow with the parachute and cap. Refer to the Galaxy parachute manual in Appendix G for more detailed information on fitting the pyrotechnic and parachute.
- Plug the lead into the Hirose socket of the U1 Lid.
- Once the preflight has been completed, and the system has been powered on and readied for flight, remove the shorting fuse to arm the parachute. The indicator light should change to green and flash slowly, a loud beep will be also be heard.

For further information refer to the Galaxy Parachute manual in the appendix.

Appendix A. **SHOTOVER CAA Certification**

CIVIL AVIATION AUTHORITY OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

Approved Person or organisation CAR 101.202

I Rex Michael Kenny, acting under delegated authority hereby approve SHOTOVER, to:

- Authorise the construction or modification of remotely piloted aircraft greater than 15 kg but not more than 30kg, and
- Inspecting and approving the construction of a remotely piloted aircraft greater than 15kg but not more than 30kg
- Authorising the operation of a remotely piloted aircraft greater than 15kg but not more than 30kg

This approval comes into force on 9 November 2015 and remains in force until 10 November 2020

Rex Michael Kenny

Manager Special Flight Operations and Recreational Aviation.

10 February 2016

CIVIL AVIATION AUTHORITY
OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

Approved Person or organisation CAR 101.202

I John Bushell, acting under delegated authority hereby approves SHOTOVER CAMERA SYSTEMS LTD, to:

- Authorise the construction or modification of remotely piloted aircraft greater than 15Kg but not more than 40Kg in accordance with Exposition Revision 3, and
- Inspecting and approving the construction of a remotely piloted aircraft greater than 15Kg but not more than 40Kg in accordance with Exposition Revision 3, and
- Authorising the testing of a remotely piloted aircraft greater than 15Kg but not more than 40Kg in test areas specified in Exposition Revision 3.

This approval comes into force on 13 January 2017 and remains in force until 12 January 2019.

John Bushell

Team Leader Airworthiness General Aviation.

13 January 2017

Appendix B. **Screw Torques**

These are the recommended torque figures for fasteners that are used in the SHOTOVER products.

Size	Recommended Torque Values	
M2.5	0.6Nm	0.4 ft-lb
M3	1.0 Nm	0.8 ft-lb
M4 Propeller Screws	0.68Nm	0.5ft-lb
M4	2.5 Nm	1.9 ft-lb
M5	5 Nm	3.7 ft-lb
1/4"	9 Nm	6.6 ft-lb

Appendix C. Fault Finding

Fault	Cause
No LED's	No Batteries Fitted. Battery polarity incorrect.
Position LED's remain flashing and initialisation beep is not heard	• Transmitter not configured correctly (Channel 5). • No GPS Lock (Status displayed on Web UI or Pilot Monitor). • Flight Controller not initialised correctly. • One of the flight controllers has not initialised correctly. Check WebUI, Multirotor screen for more info or Pilot Monitor.
Position Lights turn solid but have flash off after arming	Secondary FC not armed, Ensure the correct sequence is being followed.
Position Lights flash rapidly	Critical Error detected. Check WebUI Air tab for more Information.
Multirotor Status light flashing green	No network Connectivity.
Landing gear does not lock in the retracted position	Ensure the landing gear legs are pushed all the way into the sockets. Ensure the latch is clasped around the long M3 screw when retracted. The screw may need to be repositioned for the latch to clasp it correctly.
Altitude Hold does not function correctly.	Excessive vibration. Ensure the Prop bolt torques are correct and there are no loose fasteners anywhere. Throttle stick not within the deadband at centre stick.
Master Alarm LED state is active when the system is switched on.	One or more batteries are not charged (generates a negative current). Bad cell in one or more batteries. Faulty battery monitoring loom (disable battery monitoring to continue flying). Parachute enabled, but not fitted. Parachute disabled and fitted.
Flight Controller Error – Yaw and compass heading	Incorrect declination. Items fitted to the top of the U1 or in proximity to the compass (including GoPros). Compass/GPS mast not raised and locked. Compass/GPS mast rotated.

Pilots Monitor overlay warnings

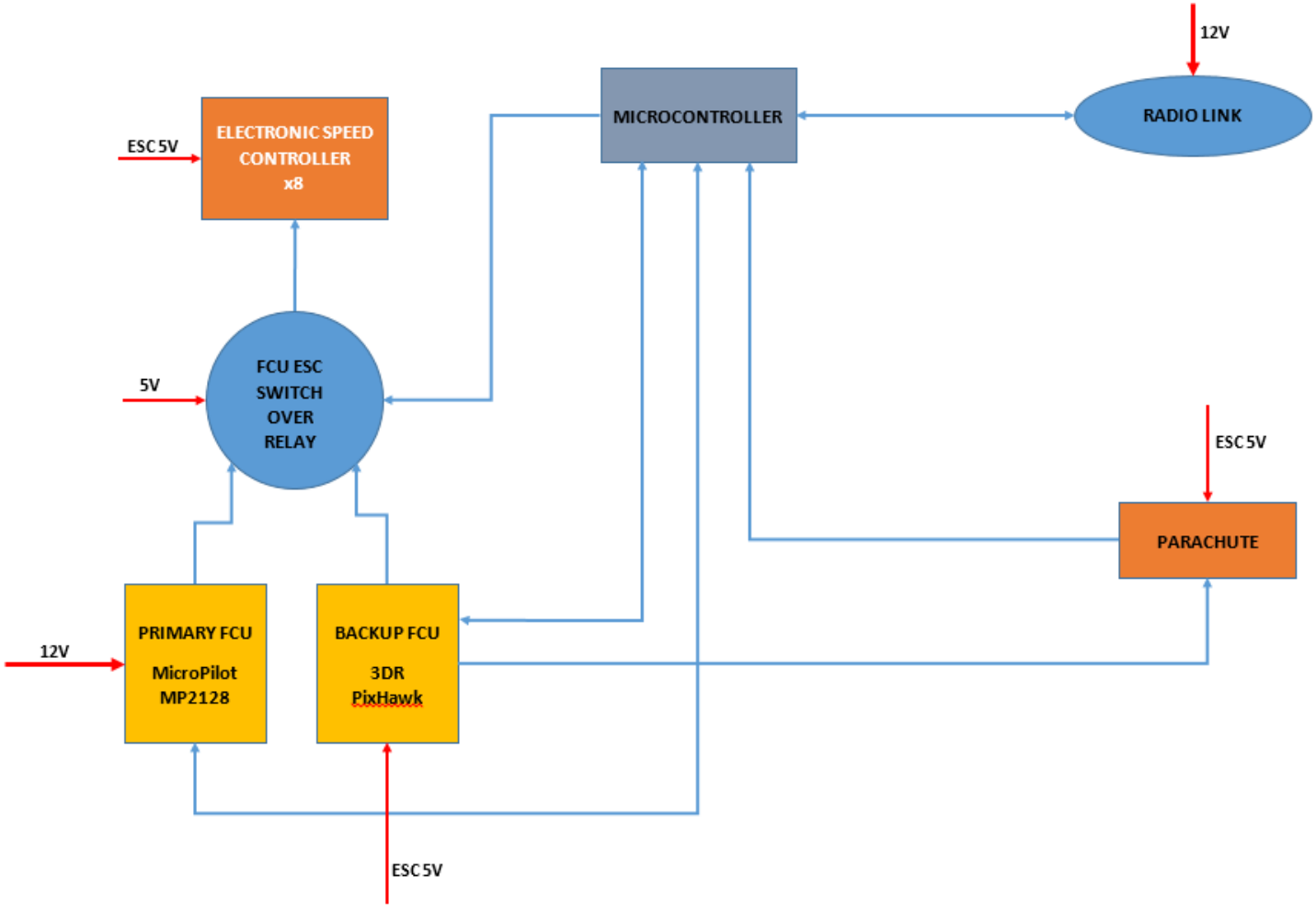
Overlay message	Warning limits	Critical Limits	Normal range	Description
Batt Warning / Critical	42 – 43.5 V	0-42 V	>43.5 V	Main flight pack voltage
Arm Temp Warning / Critical	85-100° C	>100d° C	<85°C	Motor/ESC assembly overheat
12V Ess Warning / Critical	11-11.5 V	0-11v	>11.5 V	12V #1 or 12V #2 power supply failure
5V Supp Warning / Critical	4.5-4.9v	0-4.5 V	>4.9 V	5V Power supply failure
Power1(or2) Temp Warning / Critical	85-100° C	>100°C	<85°C	Power Distribution Board temperature
Prm FC Error				Error in the Primary Flight Controller. Land and investigate.
Prm FC comms error/timeout				Communication between the primary FC and the U1 brain has been interrupted.
Sec FC Comms error/timeout				Communication between the secondary FC and the U1 brain has been interrupted.
Battery1 Cutoff				Battery string 1 has been disabled.
Battery2 Cutoff				Battery string 2 has been disabled.

Appendix D. U1 Status LED Indications

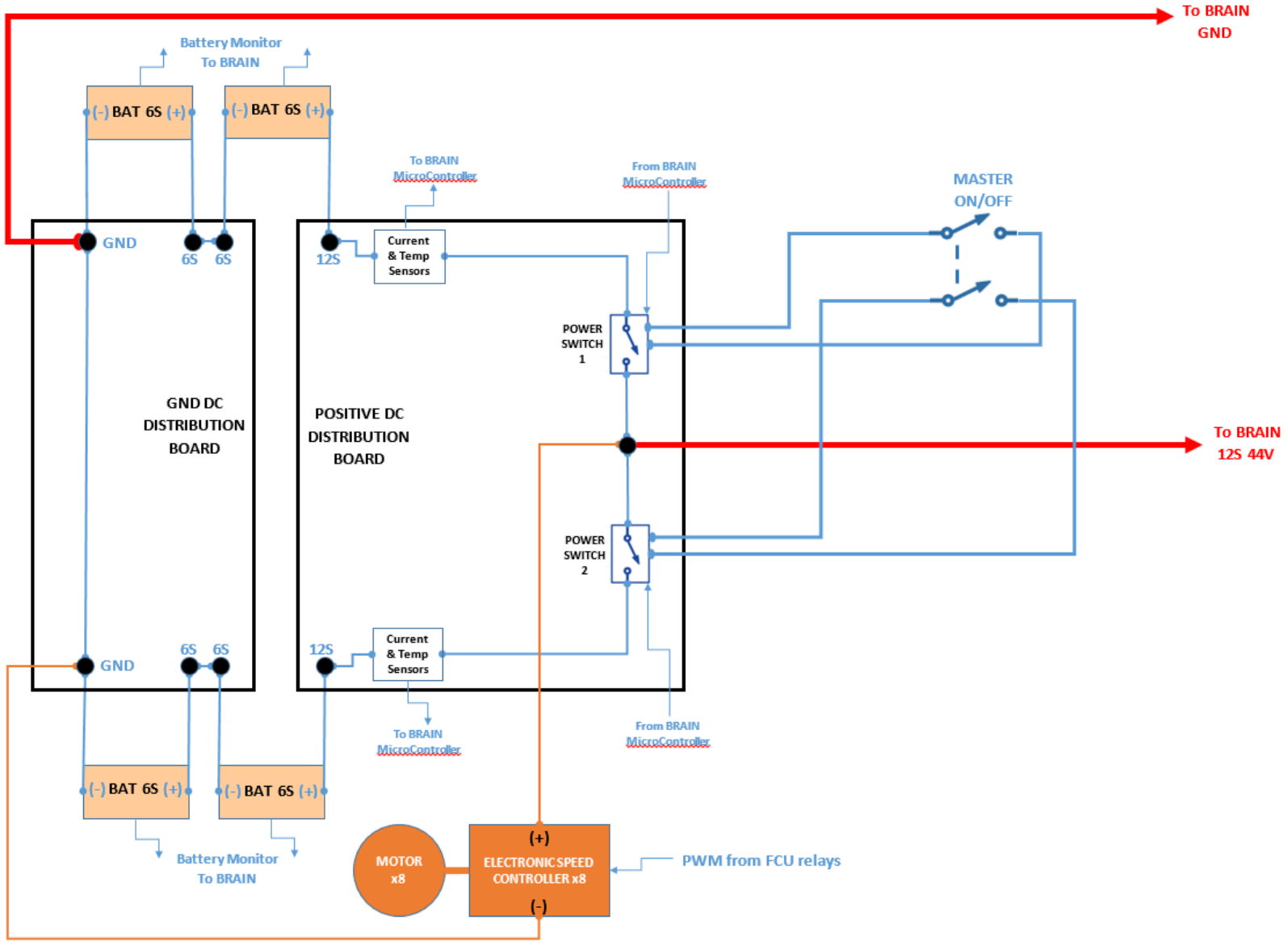
Product	Gimbal	Multi Rotor					Ground Station				
LED Label	External LED	Gimbal	Battery	Multi Rotor	Ground Station	Gimbal Controller	Gimbal	Battery	Multi Rotor	Ground Station	Gimbal Controller
LED State											
Off									Data link to MR absent G1 used without U1		
50:50 Flashing Red			One battery string not detected OR battery strings not current sharing OR multiple battery cell faults					One battery string not detected OR multiple battery cell faults			
Steady Red	Data link to GC lost OR data link to GS lost	Data link to Gimbal Brain absent	Low bus voltage OR Single battery cell fault		Data link to GS absent	Data link to GC absent	Data link to Gimbal Brain lost	Low bus voltage OR Single battery cell fault	Data link to MR acquired then lost OR Data link to MR not acquired yet		Data link to GC lost
50:50 5Hz Flashing Red/Yellow	Bootloader Fault			Bootloader Fault						Bootloader Fault	
50:50 0.5Hz Flashing Yellow	Bootloader Programming			Bootloader Programming						Bootloader Programming	
50:50 5Hz Flashing Yellow	Bootloader Waiting for Ethernet			Bootloader Waiting for Ethernet						Bootloader Waiting for Ethernet	
Steady Yellow	Bootloader			Bootloader						Bootloader	
50:50 Flashing Green	Have never had an IP address			Have never had an IP address			Gimbal Brain not found			Have never had an IP address	GC not found yet
50:50 Slow Flashing Green			1 battery string present AND string voltages ok AND battery strings current sharing AND no cell faults								Red menu active, Gimbal menu active, Mode 1 not selected at startup
Steady Green	Data link to GC present AND data link to GS present AND IP Address acquired	Data link to Gimbal Brain present	2 battery strings present AND string voltages ok AND battery strings current sharing AND no cell faults	IP Address acquired (normal operation)	Data link to GS present	Data link to GC present	Data link to Gimbal Brain present	3 battery strings present AND string voltages ok AND no cell faults	Data link to MR present	IP Address acquired (normal operation)	Data link to GC present

Appendix E. U1 Systems Connection Block Diagrams

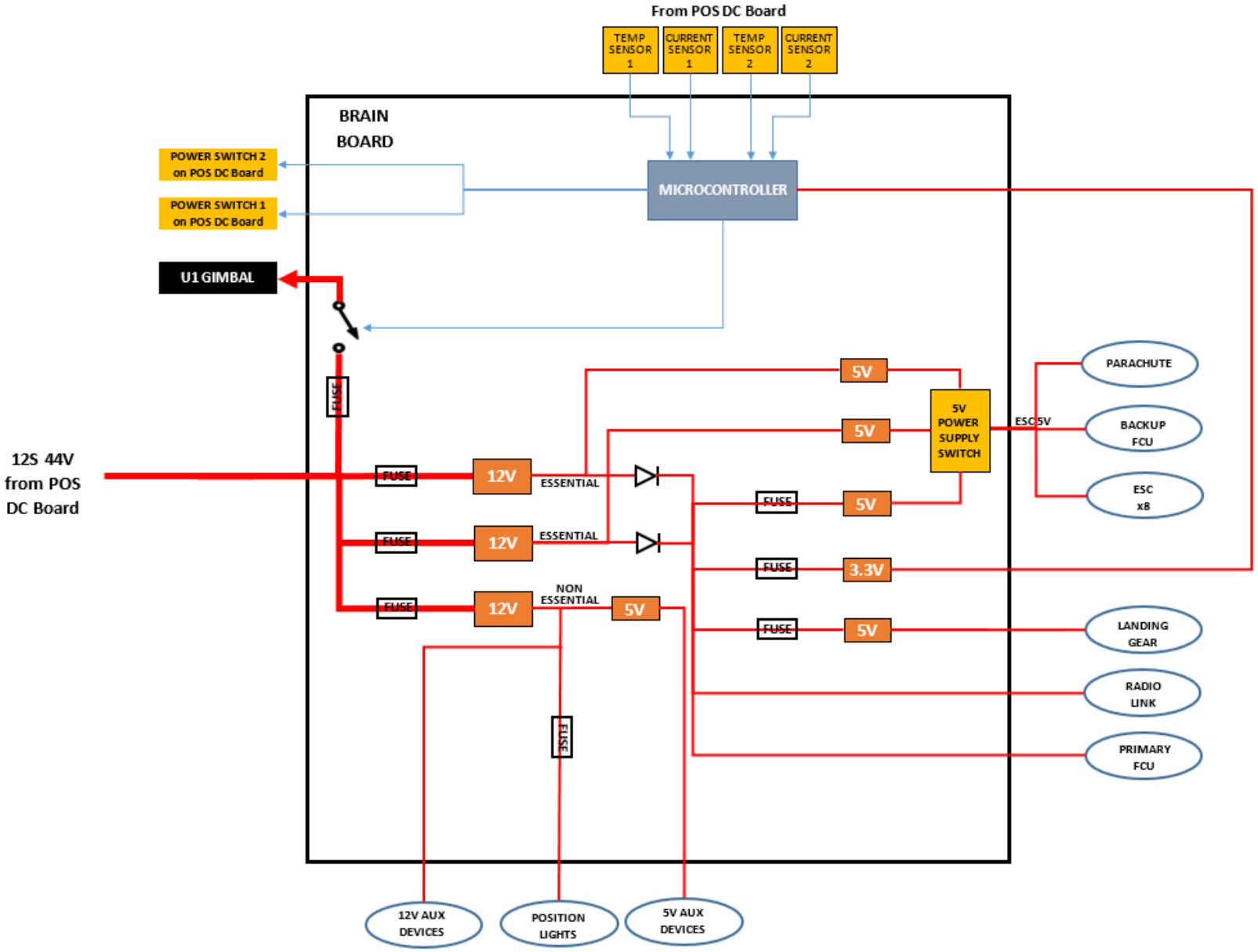
Flight Controller Interface



Main Power Distribution



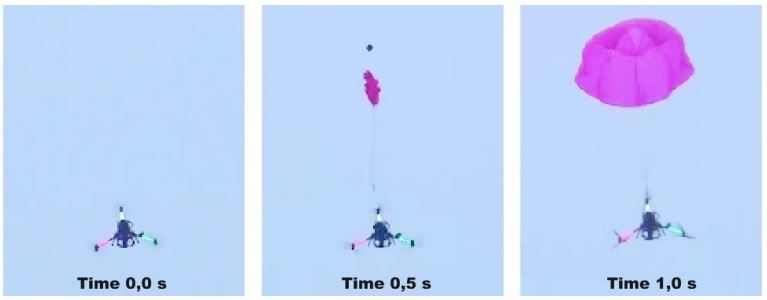
Brain Board Power Distribution



Appendix F. **Parachute.**

1. INTRODUCTION

After more than three years of intensive development works by the company Galaxy GRS s.r.o. Liberec in cooperation with the Institute of aerospace engineering of the Brno university of technology and the company RCE systems s.r.o. supported by Indet Safety Systems a.s. we introduce you to a highly efficient ballistic rescue system **Galaxy GBS 10** for unmanned aerial vehicles (UAV). Thank you for trusting in us and we hope that you will never have to use the rescue system. We wish you a comfortable flight.



Function of GBS 10 system

2. TECHNICAL PARAMETERS

U1 Series I

GBS10/350			15-35
Weight of ballistic rescue system GBS 10		**g**	725
Recommended operating weight UAV		**Kg**	**15-35**
Allowed never exceed speed TAS for use (VNE) Slider*		**Km/ h**	**80**
time of canopy opening (+0,5s to full filling chute)		**sec.**	0,8
Height of rescue		**m**	8
Descending		**m/s**	3,7-6,1
Impact energy		**J**	100-680
Method ejection			Ballistic device
tested by	VUT Brno VZLÚ Praha		Yes...Yes
Canopy			
Number of lines and panels			14
Nominal diameter		**m**	3

U1 Series II Propulsion system

GBS10/650			35-65
Weight of ballistic rescue system GBS 10		**g**	1400
Recommended operating weight UAV		**Kg**	**35-65**
Allowed never exceed speed TAS for use (VNE) Slider*		**Km/ h**	**90**
time of canopy opening (+0,5s to full filling chute)		**sec.**	1,2
Height of rescue		**m**	12
Descending		**m/s**	3,6-6,0
Impact energy		**J**	230-1170
Method ejection			Ballistic device
tested by	VUT Brno VZLÚ Praha		Yes...Yes
Canopy			
Number of lines and panels			14
Nominal diameter		**m**	4,1

Note: When testing the undercarriage, observe the probable surface of impact influencing the absorption of dynamic shock at the drone impact on the ground (grassy surface x concrete surface)

During demanding development the emphasis was placed, especially, on **reaching very high performances** to which the whole structural proposal, design as well as the production of ballistic rescue systems of series **GBS 10** were subordinated**. The system, namely, excels in**:

- **Minimum weight of rescue unit GBS 10/** in modifications **30, 50, 150, 350, 350 Speedy**, each in the basic version **BASIC** and also in the durable version **TOUGH** for professionals.
- **The lightest** ballistic rescue system in the world **in the carrying capacities 5-35kg**!
- **Quick opening** of rescue parachute by means of the pyro-actuator **up to 1 second** after the system activation /the system similar to the airbag in the car/.
- **Range of application from 3 to 35 kg** when using four sizes of ballistic equipment and five parachute canopies. An ordinary speed range and guaranteed opening is **from 0 to 80 km/hour.**
- **Minimum rescue height** – the safety height of application already in the range **from 5 to 8 m above the ground.**
- **GBS 10/350 Speedy** – the equipment is determined for fast flying models and drones up to the speed of **300 km/hour** with the time of opening **up to 2.5 second**. Minimum rescue height of this system is **30 m above the ground**.
- **Harm reduction** to your unmanned aerial vehicle, as well as **increased security on the ground** in the operational area of UAV.
- **Multiple system use –** simple process of putting the rescue unit into the operating status immediately after its field use in a very short time.
- **Usable range** for the system activation is identical with the range of your RC equipment.
- Ballistic equipment has undergone long-term testing in the **Institute of Aerospace Engineering VUT Brno** and it is **certified by the aviation testing laboratory**.
- Parachutes were designed on the basis of **measurement results in the aerodynamic tunnel in the Aerospace Research and Test Establishment (VZLÚ) Letňany** in order to reach the maximum stability and optimization of coefficient of resistance Cx.

- **TOUGH version is certified** according to applicable requirements **RTCA/DO-160G** (Environmental Conditions and Test Procedures for Airborne Equipment) guaranteeing system functionality under extreme conditions such as the **temperature range -40°C to +70°C, atmospheric humidity 95% at 55°C**, rain , increased dustiness, etc.
- Developed unit is protected by two patents and several utility models filed on the ballistic rescue system itself and the parachute.
- **Easy installation** of ballistic equipment and electronics on any UAV system.
- The device can be optionally supplied with **Engines Switch** to switch off the UAV engines with regard to the status of the safety lock and the parachute. **It serves to switch between the primary and backup flight control systems.**
- **Safety interlocking** for the transport of prepared **UAV** with an installed unit, as well as individually transported units with the installed **safety shorting fuse** and the light and acoustic indication for the unit Stand-By mode before take-off.
- **Service** and production of the unit in **Galaxy GRS in Liberec** – the company with **30 years tradition** with parachute ballistic systems.

3. SAFETY RULES

When handling the system and also during its use always pay increased attention and observe following **SAFETY RULES.** Their omission or failure to comply with may result in the bodily injury or property damage.

- **Before handling the ballistic rescue system always disconnect the power source.**
- **Before handling the ballistic rescue system always lock the system by means of shorting fuse.**
- **Ballistic rescue system prepare for operation just prior to take-off. In case you want to manipulate with system, disconnect the power supply and repeat the initialization procedure.**
- **During system charging always use protective glasses.**
- **Check the entire system before the power source is connected.**
- **Shift the lever on RC transmitter to the lower position and switch on RC transmitter and RC receiver before the power source is connected.**
- **Use only RC receivers working on 2.4 GHz.**
- **Never lean over the container with the pyro-actuator.**
- **Never point the container with the pyro-actuator either against any living person or against yourself.**
- **Before flying trigger the system by pulling out the shorting fuse.**
- **Pay increased attention during the flight.**
- **Lock the ballistic rescue system by means of the shorting fuse after landing. Then disconnect the power source.**
- **Always lock the ballistic rescue system by means of the shorting fuse during storing.**
- **Always lock the ballistic rescue system by means of the shorting fuse during transportation.**
- **The shorting fuse is the only and safety way how to prevent an intended or unintended system activation (launching the emergency parachute).**
- **Do not operate the system in close vicinity of potentially explosive area, for example, gas pipelines or gas storage, etc.**
- **For activation of system GBS 10/350 always use pyro-actuator 350 only!**

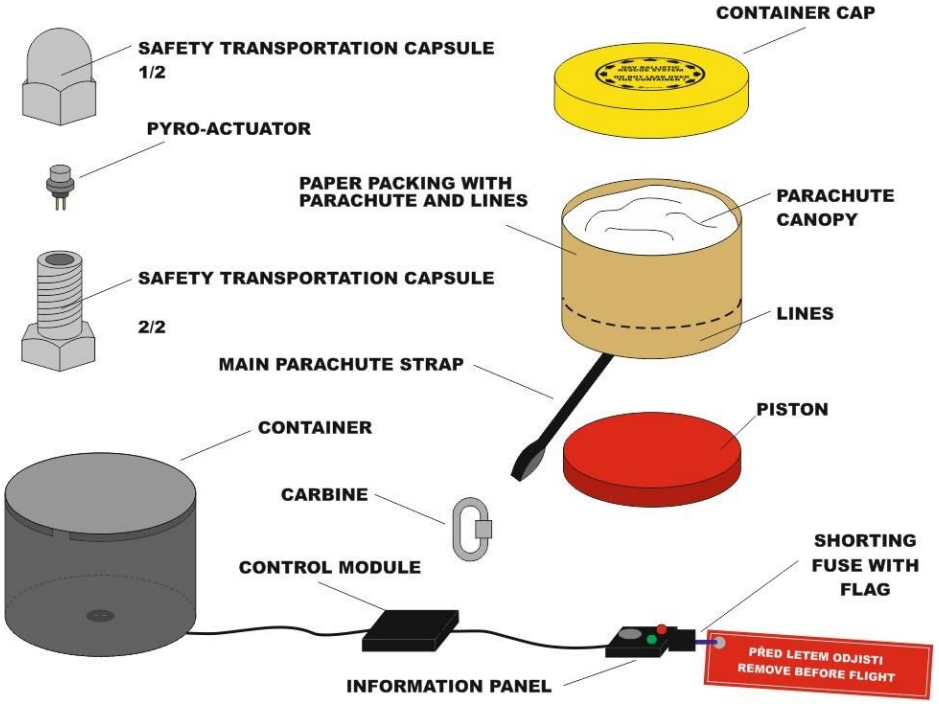
In inappropriate or improper handling an unexpected activation of the control module and launching the emergency parachute may occur. Pay increased attention during using or handling the system. Check regularly electronic modules (cabling, connectors and their any possible damage). Check the mounting of the system and electronic module to the airframe before each flight.

Connect electronic modules only according to the manufacturer's instructions. **The manufacturer is not liable for any damage caused by improper handling!**

The product, when properly installed and when used in compliance with the procedure for handling and storage, reduces significantly the likelihood of UAV and airborne equipment damage in case of UAV drive or remote control failure. In any case the user is not entitled to infringe legislative restrictions for the operation of unmanned aviation vehicles, for example, in densely populated areas, etc. Even despite the small planned impact energy the product is not capable with 100% probability to prevent any damage caused by the unmanned aerial vehicle crash. Observe the national legislation for the operation of your UAV. GBS 10 product is based on using the latest technology and components applied in aerospace, space and automotive industries. Like an airbag in a car reduces significantly the consequences of eventual traffic accident, but is not able to prevent injuries in all cases and does not entitle the driver not to obey the law, the GBS 10 system enhances security payload in your UAV and reduces the risk of damage during the fall. The system, however, is not able to completely prevent any damage or injury, and the manufacturer is not liable for them.

Galaxy Holding s.r.o. as a seller is not liable for any damages or injuries resulting directly or indirectly from the use of this product, or any other possible damages arising from the fall or operation of the unmanned aerial vehicle!

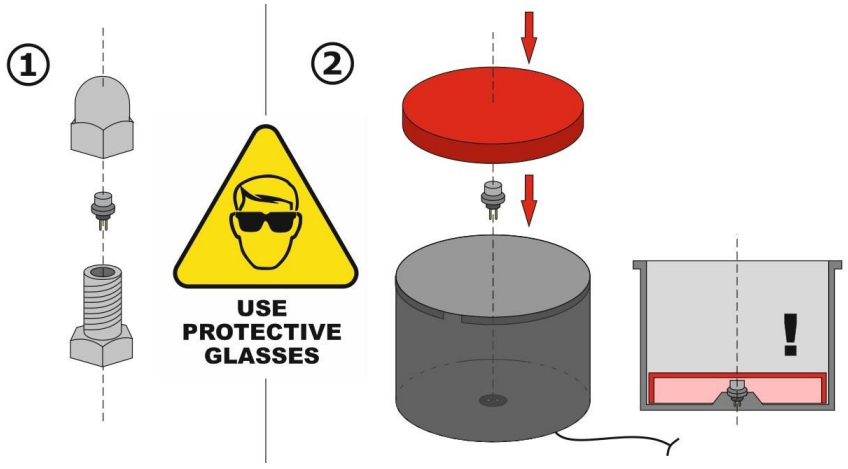
4. PACKAGE CONTENT



5. SYSTEM CHARGING AFTER UNPACKING

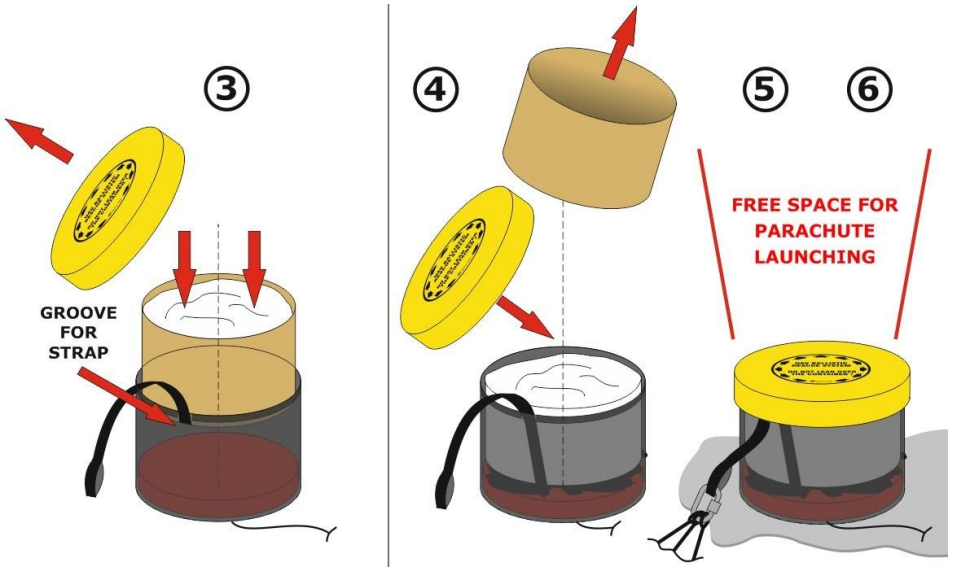
1) Each system charging should be carried out in the **dry surroundings**! Unscrew the safety transportation capsule and **take out the pyroactuator - when taking out the pyro-actuator** from the transport capsule **you are obliged to use protective glasses**. Before handling we recommend to ground both the safety capsule and the hands by grasping the capsule by hand and putting the hand with the capsule on the grounded object (such as a grounded table, space heater, metal body of water taps, possibly also on soil or grass) and to keep in the contact for the period of minimum **3 seconds**. The complete information can be found in **Annex No. 1**

2) Insert the pyro-actuator into the socket in the bottom of the container and then insert the piston. Observe **SAFETY RULES** (see Chapter 3)!



3) **Remove the lower embedding cap of the container**. Attach the paper packing on the container top and squeeze the parachute with lines through this packing inside the container. Direct the main parachute strap into the groove in the reinforced upper edge of container rim and leave its end outside the container for the carbine connection.

4) **Remove the paper packing**, put on the container cap on the cylinder top.



5) **Fasten the container** as close as possible to the centre of your UAV by means of Velcro fastener. **Above the container shall be no obstruction** that would prevent the safe deployment of the parachute. In case of internal installation of the ballistic rescue system **use the canopy (cover) authorized by the manufacturer**. The canopy must pass the test ensuring the safety passage of launched parachute.

6) **Connect the end of the main parachute strap with the suspension system** (system of straps, ropes, etc.) **by means of carbine**. The UAV should descend in the horizontal position.

7) Fasten the information panel with the shorting fuse so that the **shorting fuse is in the conspicuous and accessible place**.

6. ELECTRONIC SYSTEM

6.1 Electronic system properties

- Electronically controlled launch of the ballistic rescue system.
- Two independent control signals (PWM from RC receiver, digital signal 0-5V).
- Active monitoring of pyro-actuator condition.
- Electrical locking against unintended launch.
- Error messages by means of digital outputs (style open collector).
- Error messages by means of LED diodes and acoustic signal.
- Signal ready to launch.
- Power supply 5V – 7V.
- Switching between the primary and backup flight control systems (version with Engines Switch).
- Switching off the engines with respect to the status of the safety lock
(fuse) and the parachute launching system (version with Engine Switch).
- Switching up to 8 engines (version with Engine Switch)

6.2 Description

The electronic system consists of two parts: the control module and information panel. For the proper operation of the ballistic rescue system you should always use both modules supplied by the manufacturer. Use only accessories supplied by the manufacturer.

The control module serves for the ballistic rescue system activation. It is possible to activate the system by means of operator's RC transmitter, computer, or other electronic equipment that will be on board of the unmanned aerial vehicle. The information panel signals the condition of the whole system to the user and provides for the safety locking of pyro-actuator.

The control module is supplied with optional integrated Engines Switch. It´s described in a separate chapter. The differences between versions with and without Engines Switch are mentioned at the appropriate places in the manual.

6.2.1 Control Module

After powering the supply voltage the control module will check the conditions for take-off (pyro-actuator connected, shorting fuse disconnected, signal of module activation absented). In case any of the conditions is not met, the module signals an error on the information panel. In this case it is necessary to eliminate the error. Possible problems are:

- Disconnected, or already used pyro-actuator.
- Active signal for launching on pin No. 1 of CON-PWM connector (lever on the RC transmitter in the higher half of its scale).
- Active signal for launching on pin No. 1 of CON-DIGI connector (logical 1 on the digital input).
- Shorting fuse connected.

When all errors are eliminated and the safety lock removed the module will beep briefly and the green LED diode starts blinking on the information panel.

At this moment it is possible to activate the ballistic rescue system at any time. Therefore pay the increased attention to its handling. The activation may occur under following conditions.

- The lever (of the switch) on the RC transmitter is shifted to the upper position for the period of at least 0.2 second.
- The digital signal (log. 1) is received for the period of at least 0.01 second.

After receiving one of activation signals the pyro-actuator will be fired and the rescue parachute launched. Subsequently the module will be deactivated and logical value 0 (0V) set on pin No. 1 of the CON-MOTOR connector.

Use the voltage of 5V for the control module, preferably from the RC receiver. An average current consumption is up to 50mA, peak power consumption is up to 2.1A.

6.2.2 Information Panel

The information panel is equipped with red and green diodes. They serve to inform the user about the current status of the module:

- **Green LED on** – module is starting.
- **Green LED blinking** – module is OK and ready for activation.
- **Red LED blinking (briefly)** – module is locked with the shorting fuse and/or the pyro-actuator is not connected (CON-PYRO connector), and/or the pyro-actuator is already used.
- **Red LED blinking (long)** – module was switched on with the active signal for detonation (firing). Deactivate the signal for detonation.
- **All LED diodes lighting** – pyro-actuator is being activated (for the period of 5 seconds).
- **No LED is lighting or blinking** – module is off.

The module is also **equipped with an acoustic signalling**. Possible signals are as follows:

- **One very short beep** (0.025 second) – supply voltage was connected to the module.
- **One long beep** (1 second) – module is ready to be used.
- **One very long beep** (5 seconds) – ballistic rescue system has been activated.
- **Regular beep (briefly)** – module is locked with the shorting fuse and/or the pyro-actuator is not connected (CON-PYRO connector), and/or the pyro-actuator is already used.
- **Regular beep (long)** – module was switched on with the active signal for detonation (firing). Deactivate the signal for detonation.

6.2.3 Engines Switch – version EXTENDED

Engines Switch is used to safely stop UAV engines. It blocks the engine control and the UAV taking off until the parachute safety lock is removed. It switches off the engines after receiving the activation signal to launch the parachute. This prevents possible entanglement or cutting the parachute cords. Additionally it allows installing two flight control systems (primary and backup) on UAV and switching between them during the flight. When the primary system fails operator can switch to the backup system. After failure of both of them the engines are switched off and the ballistic rescue system is activated.

6.3 Connection

Connect electronic modules according to one of possible ways.

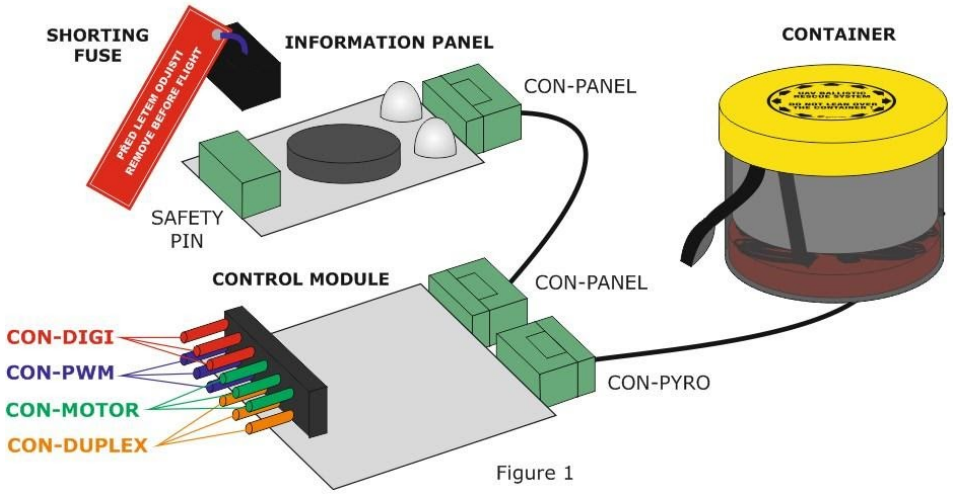


Figure 1

6.3.1 Minimal Configuration

First connect the information panel to the control module by means of six-wire cable completed with MPX6 connectors. Then connect the pyro-actuator by means of two-wire cable completed with MPX6 connector.

Subsequently it´s necessary to connect the power supply and activation signals.

A) The version without Engines Switch - STANDART:

You can connect CON-PWM connector directly into the receiver from radio by means of three-wire modelling cable (included in the package). Pinouts are identical as on the RC receiver (PWM, VCC, GND).

B) Version with Engines Switch - EXTENDED:

In this version it´s only possible to activate the parachute using the RC radio, not via the digital output. Attention: The receiver must be connected into the connector labeled CON-RX not into connector CON-PWM.

Engines connection is described in **Section 6.3.3**.

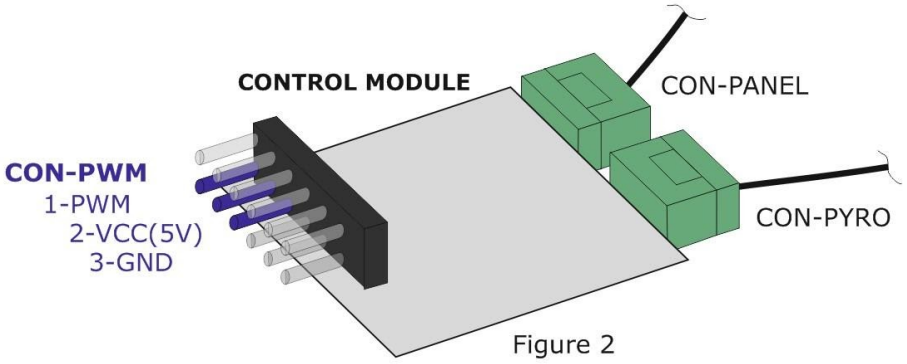


Figure 2

CON-DIGI connector has the same pinouts as CON-PWM connector (DIGI, VCC, GND). For connecting it you can use a three-wire modelling cable. The first pin marked as DIGI is used for the activation. Bringing the digital signal with the value of logical 1 (5V) results in launching the rescue parachute.

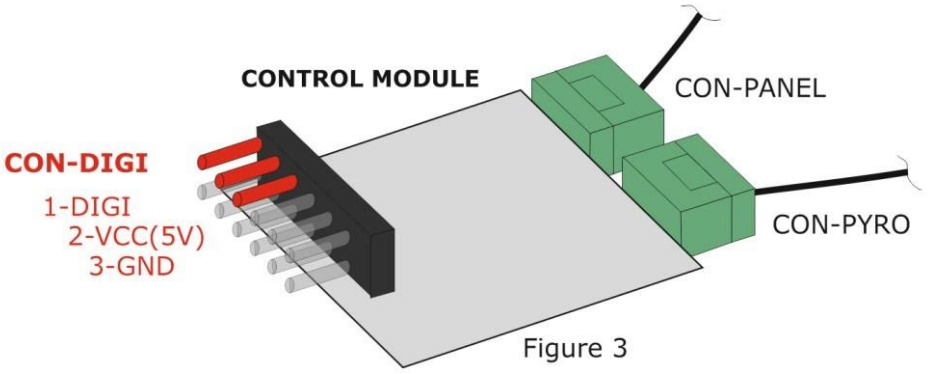


Figure 3

6.3.2 Maximal Configuration

Connect everything according to the Chapter Minimal Configuration.

CON-DUPLEX connector comprises two signals with a feed-back signalling an error on the equipment. The first output on pin 1 signals a problem with the pyro-actuator (i.e. shorting fuse connected, and/or the pyro-actuator not connected). The second output on pin 2 signals an active input signal on CONPWM connector and/or CON-DIGI connector. Internal connection is illustrated in left figure. It is an open collector connection that is used for the units Duplex of the company JETI.

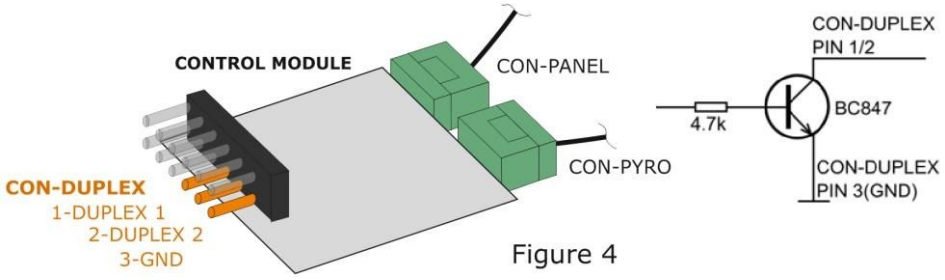


Figure 4

CON-MOTOR (MOTOR-READY) connector is used to inform the external module about the readiness for the parachute launching.

After turning on the electronic system, the MOTOR signal is set to log. 0 (0V).
When the electronic system is ready for launch, the MOTOR signal is set to log.
1 (5V). After successful launching of parachute, the electronic system sets the MOTOR signal to log. 0. In case that during the flight occurs a mechanical disconnection or shorting of pyro-actuator, the electronic system will not be ready to launch the parachute. This will be reflected also on the MOTOR signal.

If the system has an engine switch, this signal will ensure that:

- UAV cannot take off until the unit is ready for launch.
- After a successful launching of parachute is not possible to turn on the motors

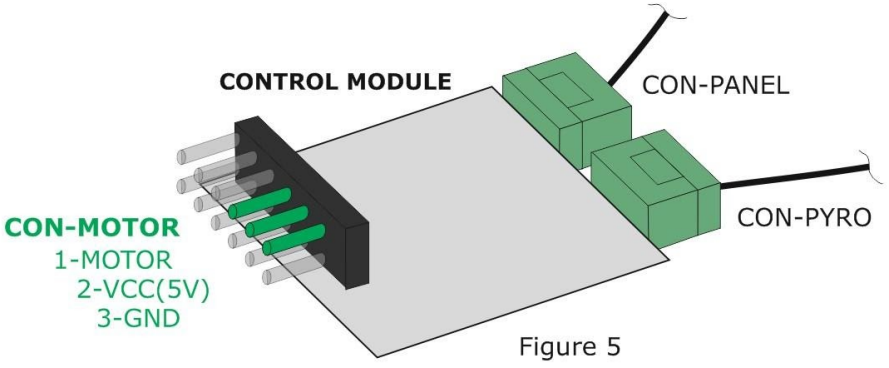


Figure 5

6.3.3 Engines Switch – version EXTENDED

6.3.3.1 Engines Switch connection

This chapter covers the control module with integrated Engines Switch. The information in **sections 6.3.1 and 6.3.2** is valid to this configuration unchanged.

In order for to fulfil the function of the Engines Switch the engines control signals must pass through it. The outputs from the UAV flight control system to engines controllers must be connected into the inputs of Engines Switch. If you have one flight system, connect the cables into the connector CON-IN1. In case you have two flight systems, connect the primary one into the connector CON- IN1 and the backup system into the connector CON-IN2. When connecting the cables you need to follow the same order (1-8) on input as on output.

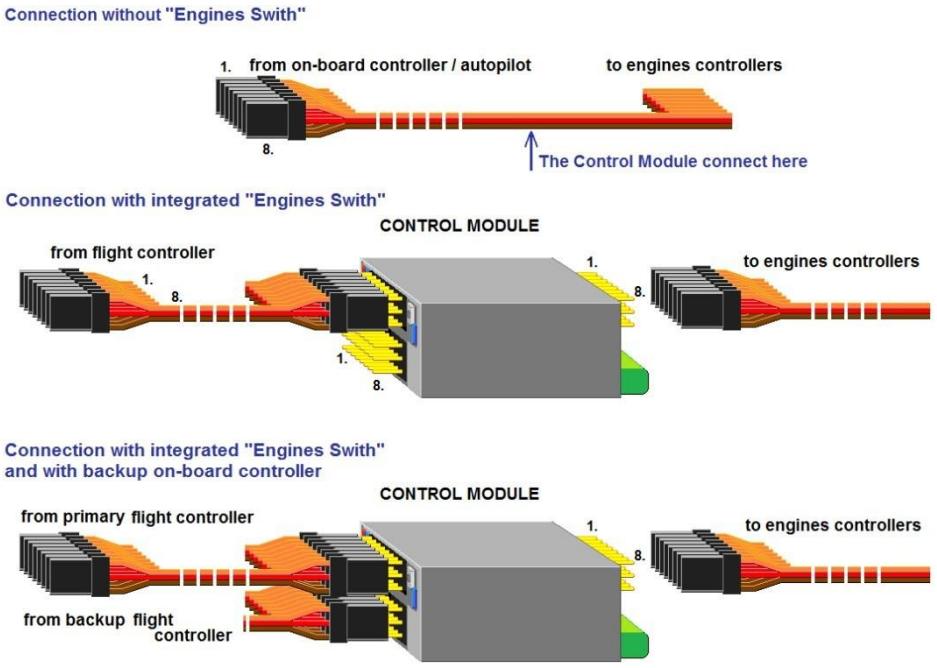


Figure 6

For connections the classic three-wire cable can be used. Minus poles (brown wire) of all inputs and output connectors are connected together to the ground. Plus poles (red wire) of the CON-IN1 and CON-IN2 connectors' don´t pass through the Engine Switch. The plus poles of CON -OUT connector are all powered by 5V from the module internal source. **ATTENTION**: If the engines controllers have its own power on the red wire, for example to supply the receiver, **does not connect** the red wire into the connector CON-OUT. In such case only brown and yellow wires can be used to connect the controllers to Engines Switch. **The red wire must be cut or removed from the connector, insulated and fixed as to prevent accidental contact with conductive parts of electronics and construction.**

The control unit of the Engines Switch connects on its side ground (-) on the connectors IN1, IN2 and OUT. If grounds of all systems of UAV are properly connected into a common point than it´s not necessary to repeat this connection and it´s only enough to interconnect the signal wires (yellow).

Alternatively for security reason one brown wire between Engines Switch and each attached flight control system. See Fig. 7

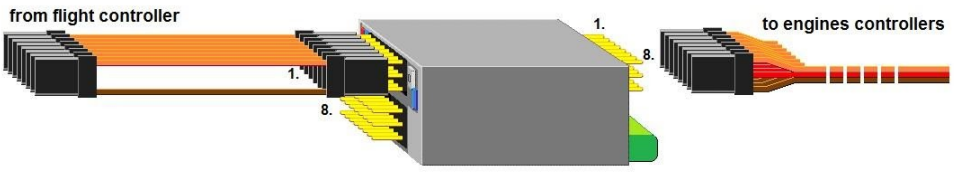


Figure 7

6.3.3.2 Engines Switch adjustment

For proper Engines Switch functioning in the specific UAV it´s necessary to verify and adjust the following:

1) The required power source for the control module

In the factory setting the control module is powered from the receiver (CON-RX connector) with an expected range of 5V - 7V. Make sure, your receiver is strong enough to supply a durable power to the control module and also the current pulse when the parachute is activated (see Chapter 2 Specifications). If not, the unit can be configured to be powered from an external power source.

The control module is powered from the receiver if the jumper is inserted at position J1 (front panel of the control module). To switch to an external source remove the jumper and move it to the position J4 (rear panel). External power connector is located under the jumper J4 (See Fig. 8 for pinouts).

If you want to connect the emergency buzzer, the control module can be powered directly from the receiver and jumpers J1 and J4 must be inserted.

2) The basic period of PPM signal for switching engines off (10 ms or 20 ms)

During the normal operation the signal passes from the UAV flight control system through the Engines Switch without changes. After receiving the instructions to activate the ballistic rescue system, signal path is interrupted and the PWM signal is sent to the engines to ensure their shutdown. The period of this signal can be set to 10 or 20 ms which represents frequency 100 or 50 Hz. The jumper J3 positioned at the front of the control module is dedicated for this purpose. Inserted jumper J3 sets the period of 10 ms, removed jumper J3 sets 20 ms.

3) Settings of the OFF-mode signal level

The trimmer T1 located next to jumper J3 on the front panel allows setting the level of the signal that is being sent to in off-mode to ensure the engines stop turn. The trimer allows to set pulse width from 0,95 up to 1.95 ms.

4) Setting to work with backup system

Jumper J2 located on the front panel of the control module sets the working mode with or without a second (backup) flight control system. The removed jumper J2 sets the mode to work without a backup flight control system (two-position control). Inserted jumper J2 sets the mode to work with a backup system (three-position control). See Fig. 9

Three LEDs that indicate the engines working status (primary, backup, off). They are located at the rear panel.

Figure.8. Connectors and jumpers placement

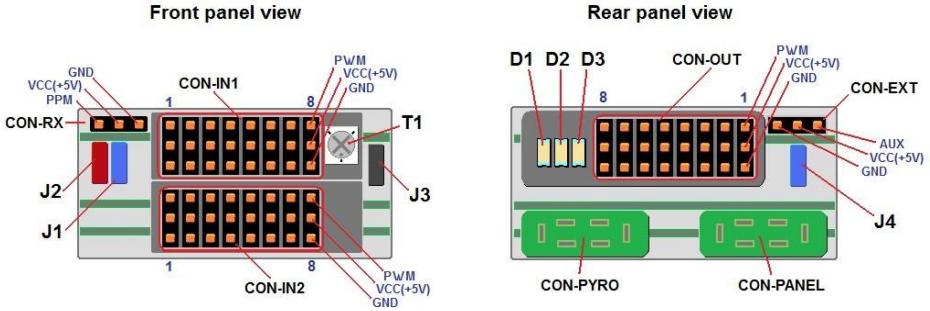


Figure 8

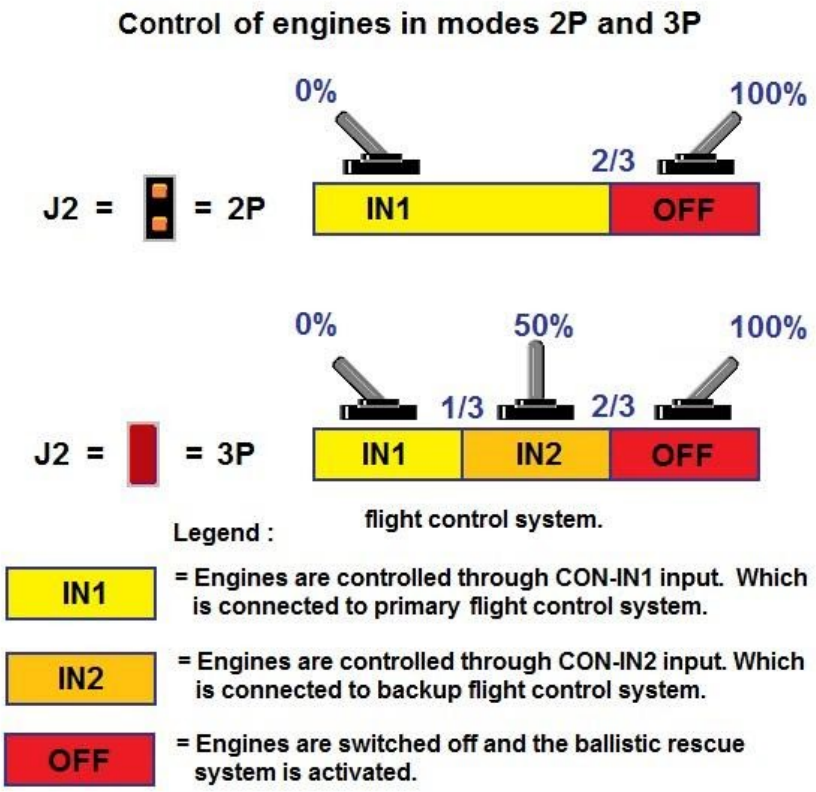


Figure 9

6.4 Turn on Procedure

Before putting the module into operation check the following:

- Connection of cables.
- RC transmitter and RC receiver switched on (in case RC receiver is used for the activation of ballistic rescue system).
- Activation selector of the ballistic rescue system on the RC transmitter in the position „deactivated“ – i.e. on the minimum value.
- Digital signal for the rescue system activation in logical 0.
- Shorting fuse inserted.

After successful system checking connect the control module to the supply voltage. **Never switch on the RC transmitter when the RC receiver is already switched on, i.e. when the control module is switched on.** Provided the module beeps shortly and the green LED diode starts blinking, you can safely take-off with the prepared ballistic rescue system on your unmanned aerial vehicle.

6.5 Verifying Model Functionality

It is possible to test in which position of the lever on the RC transmitter the rescue parachute is launched. Is it possible to test that the module responds correctly?

Yes. But it is necessary to observe the following procedure.

1) Disconnect the pyro-actuator (CON-PYRO connector).
2) Set the lever on the RC transmitter to position „deactivated“ (lower half of the scale)
3) Connect to the power supply.
4) Red LED diode on the information panel starts blinking shortly (15% on, 85% off).
5) Switch the lever on the RC transmitter to position „activated“.

6) Red LED diode should change the blink rate(50% on, 50% off).

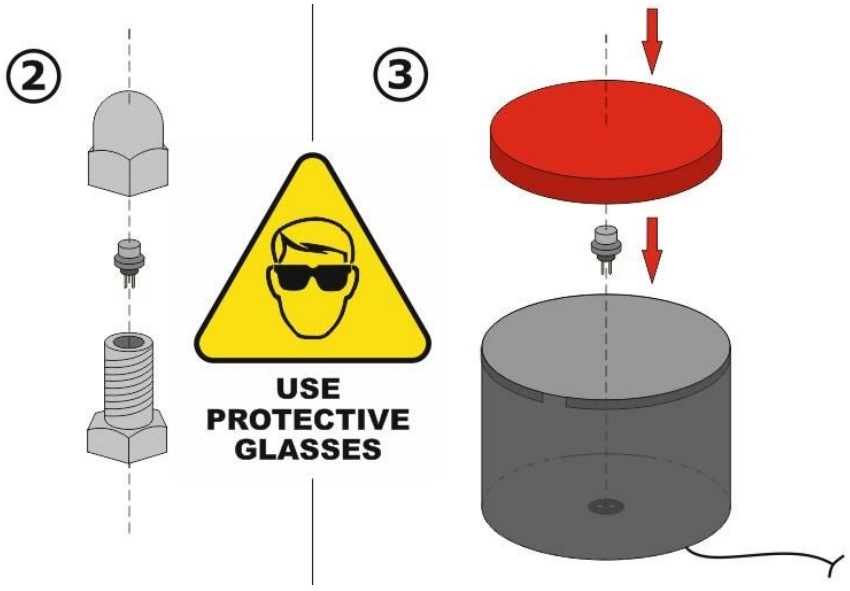
SYSTEM RECHARGING AFTER ITS ACTIVATION

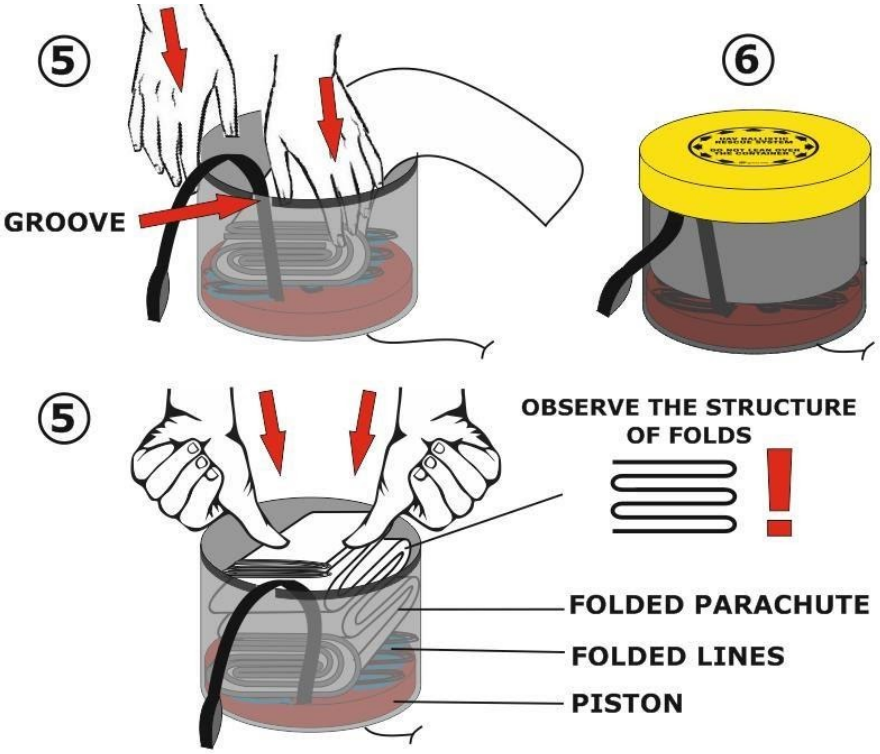
After each use of the rescue system it is necessary to check all parts of the assembly, mainly the cylinder, piston and electronic modules including their interconnection **see Chapter 9**. In case of any damage contact the manufacturer. Provided the system is without any damage, you can start to recharge it. Make the record in the table - **Annex No. 3.**

Observe **SAFETY RULES** (see Chapter 3)!

7.1 System Recharging Procedure

1) Remove the used pyro-actuator from the socket in the bottom of container.
2) Unscrew the safety transportation capsule and take out the pyroactuator – when taking the pyro-actuator out, observe the rules according to **Chapter 5 Item 1).**
3) Insert the pyro-actuator into the socket in the bottom of container and then insert the piston. Observe **SAFETY RULES** (see Chapter 3)!
4) Pack the parachute with lines carefully according to **Chapter 7.2**.
5) Insert the carefully folded lines inside the container. Direct the main parachute strap into the groove in the reinforced upper edge of container rim and leave its end outside the container for the carbine to be connected. Press the folded parachute gradually with your hands – the best with thumbs – inside the container in the form of „harmonica", starting from the bottom part of parachute according to figure 5.
6) Put the cap of container on its top
7) Fasten the container on your UAV by means of the Velcro fastener.
8) Connect the end of the main parachute strap with suspension straps by means of the carbine.
9) The system is charged and prepared for the next use.



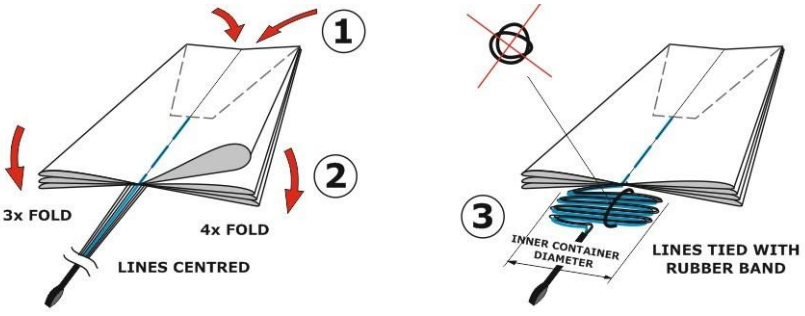


7.2 Parachute Packaging

1) Check whether **there was no damage on the parachute, lines or the main parachute strap** during the rescue of your UAV. Make sure that the lines are loose (they do not cross) and tighten them all (including the central line leading to the upper parachute opening). Thus the upper part of the parachute falls inside the parachute. Check whether the parachute is not damp or wet.

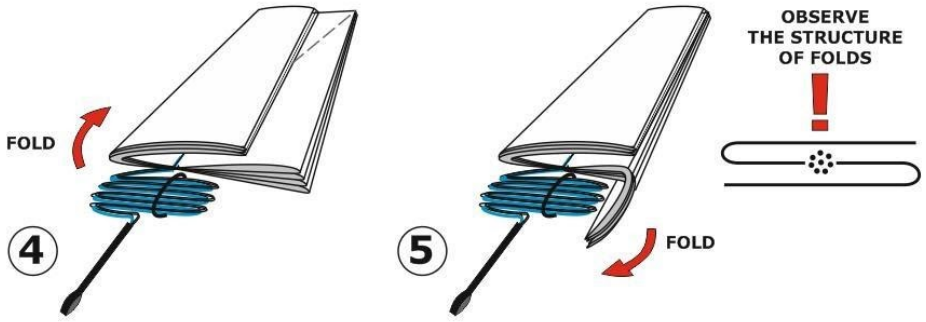
2) The parachute has 7 cells. Fold each cell in half so that all the lines come out from the centre of the parachute and divide the folds in the ratio 3:4.

3) Fold the tighten and aligned lines in the form of „harmonica“ and lock them together with a thin rubber band according to the figure. Do not fold the rubber band – rather looser enlacement! The length of folds should be approximately equal to the container diameter.



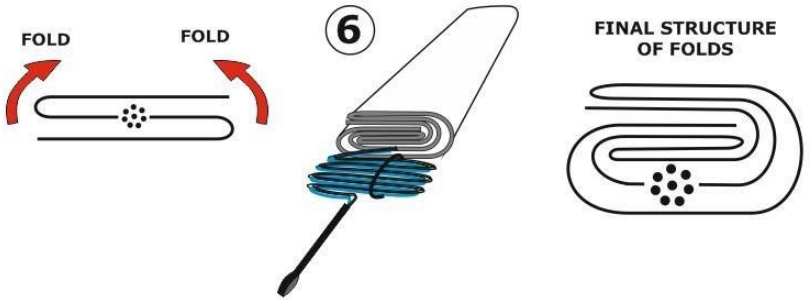
4) 2/3 of the **left** folds fold toward the center of the parachute.

5) 2/3 of the right folds fold toward the center of the parachute, but on the opposite side. Lines must still be centered relative to the **parachute**.



6) The left and right part of folded parachute fold over each other according to Figure 6. It is important to **preserve the structure of folds!** Now the parachute is ready to be pressed into the container.

Continue in the procedure with Item **5) in Chapter 7.1**



8. PROCEDURE FOR SYSTEM FAILURE

Despite of all the efforts put into the reliability of the system in the course of its development, absolutely exceptionally a situation may occur when the system does not respond to the transmitted signal to activate it. In such a case proceed according to the following steps. It is necessary to identify the cause of failure. The pyro-actuator itself is tested with extreme requirements as to its reliability and therefore it is necessary to exclude other more likely potential causes of system failure before its disassembly. If the crash of the unmanned aerial vehicle with the ballistic rescue system on board takes place, be very careful upon the inspection after UAV hitting the ground. Keep away from the system in the direction of potential parachute launching, i.e. in the direction towards the container cap.

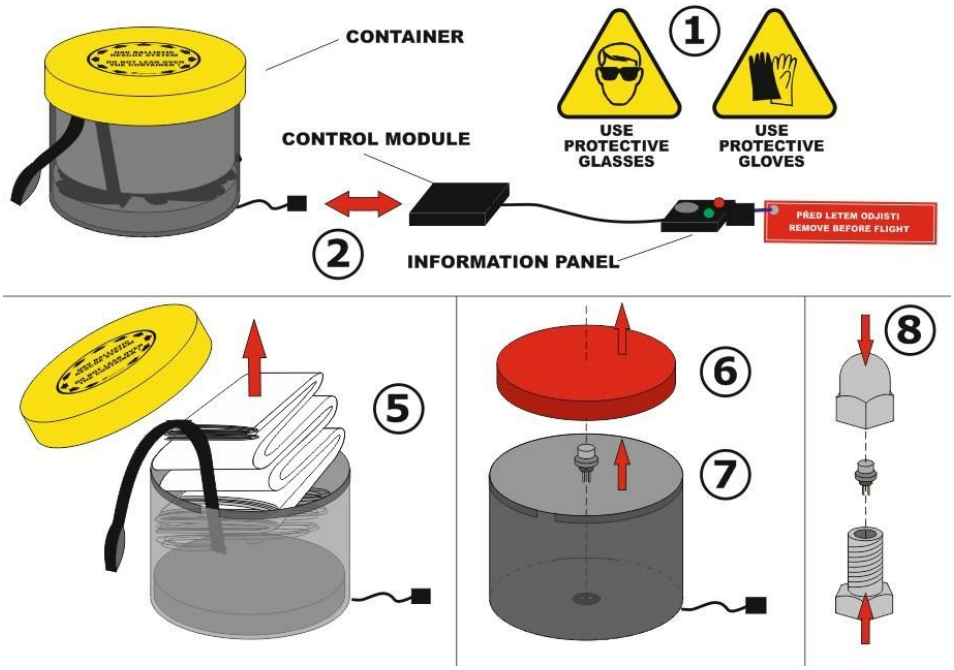
Do not switch off the RC transmitter before coming to the wireless UAV equipment. After coming check the information panel – whether it signals the system running (blinking of green/red diode, possibly acoustic signalling). Make note of this information. Only then disconnect the power source from the unmanned aerial vehicle and subsequently the RC transmitter.

1) Check whether the shorting fuse was removed before the take-off. If not, the system was OK.

2) In case the control module and information panel have not been mechanically damaged, disconnect it and subsequently check the function of both modules according to Items 6.4 and 6.5 of this User's Manual. Provided the unit responds to the signal for launching according to Item 6.5, the control unit is OK.

3) In case any of the modules has been damaged, send it to the manufacturer with the description of the event.

In case no cause of failure has been found out during the inspection carried out according to Items a) and b), it is necessary **to dismantle the pyro-actuator** from the system and send it to the manufacturer in the original packing. The procedure of dismantling is as follows:



1) Prepare protective glasses, gloves and the tool for removing the pyroactuator (combination pliers as the best).
2) Disconnect the control module from the rescue system(CON-PYRO connector)
3) Make access to the container with the rescue system. **DO NOT LEAN OVER THE CONTAINER!**
4) Remove the container cap.
5) By gradual pulling remove the packaged parachute from the container.
6) Remove the piston from the container.
7) Using the pliers remove the pyro-actuator carefully from the socket.
8) Insert it to the safety transportation capsule and lock it by screwing.
9) Send the pyro-actuator to the manufacturer.

9. WARRANTY AND CONSUMER TIME

Warranty period is two years from the purchase of GBS10 system. The date of purchase and date of manufacture of the ballistic rescue system are marked out in the warranty certificate.

Service life – The system is possible to be used repeatedly. In the course of testing the rescue unit was loaded with a series of seven launches without any damage. To ensure the proper function of the ballistic rescue system, it is necessary to carry out regular inspections of all parts of the assembly not only after launching, but also during the use of the unmanned aerial vehicle (influence of vibrations, dynamic impacts when landing, etc.)

The manufacturer recommends carrying out the inspection of these parts:

PREVENTIVE INSPECTION	INSPECTION AFTER SYSTEM ACTIVATION

1) Electronic modules – inspection of cables, plugging of connectors and their possible damage **2)** Fastening of the system and electronic module to the UAV airframe **3)** Joining the main parachute strap with the suspension system (straps, lines) **4)** Inspection of the suspension system in the UAV suspension points **5)** In the direction of the rescue parachute launching shall be no obstruction or, for example, part of installed on-board equipment or any cables **6)** Inspection of container cap closure tighten with the Velcro fastener	**1)** Detailed inspection of the internal and external parts of container **2)** Piston inspection **3)** Parachute inspection **4)** Inspection of parachute lines and the main parachute strap **5)** Inspection of suspension system – possible damage from rotors **6) After recharging** – all steps from the preventive inspection

In case of any damage or doubts do not hesitate to contact the manufacturer.
Spare parts and accessories may be purchased directly from the manufacturer. 10 STORING

Optimal storing temperature is **14 –24 °C** with air humidity 35-73%! Ballistic rescue system is designed for the limiting values of use from **–20°C to +40°C**! Nevertheless, we cannot recommend permanent exposition of the system to these temperatures and exceeding **the recommended humidity values** during storing!

The manufacturer prohibits to expose the system to high temperatures, hard impacts, mechanical damage, acids, aggressive chemicals, long-term storing in excessive humidity and permanent vibrations!

Warning – The system must be handled as pyrotechnic equipment and any person is prohibited to move in the direction of parachute launching, or to aim at his own body with the unlocked system!

10. TRANSPORT

The safety transportation capsule serves for the safety transport of individual pyro-actuator pieces with the maximum portion of pyrotechnic charges up to 500mg and in compliance with the documentation ISV 2198, according to which the capsules were certified by the notified European testing laboratory (No. 1395, Konštrukta Defence a.s., Slovakia). Thanks to this it is possible to transport the product by means of the classical mail as the explosion-proof equipment. Based on fulfilling the prescribed legislative UNO conditions for declassification of the product from the exclusive Class 1 for the transport of dangerous goods there was issued Resolution No. SK/KTD018/14 the copy of which you may find in **ANNEX NO. 2**. The product cannot be transported via air transportation and it is subject to special provisions in the territory of the USA. For further possibilities of transportation and the transportation in the USA contact the manufacturer.

1. ANNEXES

ANNEX NO. 1 – Safety Transportation Capsule for the transport of pyroactuator – manufacturer ISS a.s.

Use

Safety transportation capsule is used for the safe transportation of individual ISS´s pyrotechnic products with the maximum amount of pyrotechnical charges up to 500mg and in compliance with the documentation ISV 2198 submitted to the certification process by European Notified Testing Laboratory (No. 1395, Konštrukta Defence a.s., Slovakia). Based on fulfilling the prescribed UNO legislative requirements for the declassification of dangerous goods from Class 1, there was issued Resolution No. SK/KTD018/14.
The copy of this document must be attached to each delivery of products in the safety transportation capsules.

Description of Product and Safety Measures:

Safety transportation capsule is composed of screw body with an internal cavity for installation of non-detonating pyrotechnic article and of threaded cup. The cup and body are screwed tightly together using 2 spanners or other suitable tools. Subsequently the capsule containing the squib is packed and as a standard mail delivery can be transported by standard delivery services like Post as non-dangerous goods. Attention! This information is not valid for the U.S. territory where an additional approval from DOT is required. Filling of capsules with squibs is done by the manufacturer.
Upon removing the squib from the safety capsule always wear protective glasses (dioptric or sun glasses are enough). We recommend effectuate grounding of safety capsule and operator´s hands by touching grounded metal objects (like grounded metal table, space heater, metal body of water taps, possibly also on soil or grass) and to keep in the contact for the period of minimum **3 seconds**. After this procedure you can disassemble the safety capsule by means of two socket spanners or other suitable aids and remove the pyrotechnic squib for the next use.

The safety transportation capsule may be used repeatedly (as returnable packaging) provided that in terms of using it is not excessively worn out, or corroded, which prevents easy disassembly or safety removal of its content. When the product is removed from the safety capsule, it is again categorized as a pyrotechnic article for other uses of category P1 (with low hazard) in compliance with the valid regulations of the European Union. Its acquisition, handling or use could be treated under the specific legislation in the country of use. Fulfilling of these requirements is always a responsibility of the distributor and user of our products.

Important additional information:

Attention! The use of safety capsule does not exempt from the obligation to observe the legislation for the pyrotechnic articles in the user's country. The safety capsule is only the approved means for the safety transportation of pyrotechnic articles! Indet Safety Systems a.s. prohibits all and any adjustments of safety capsules. Any other use than prescribed and approved of is strictly prohibited. In case of any breach of these regulations and instructions mentioned above the company Indet Safety Systems a.s. assumes no responsibility for the caused damage. If needed, please, contact us at phone No. +420 571 425 001 or by e-mail info@iss-cz.com.

ANNEX NO. 2

KONŠTRUKTA – Defence a.s.
Prevádzka špeciálneho skúšobníctva, 018 41 Dubnica nad Váhom
Autorizovaná osoba SKTC – 112

ROZHODNUTIE č. SK/KTD018/14

Resolution № RZ – SK/KTD018/14

o deklasifikácii nebezpečných vecí triedy 1 – Výbušniny v zmysle Európskej dohody o medzinárodnej cestnej preprave nebezpečných vecí (ADR).
on declassification of dangerous goods of Class 1 – Explosives in sence of International Transportation of Dangerous Goods by Road (ADR).

Toto rozhodnutie sa vydáva na základe poverenia Ministerstva dopravy, pôšt a telekomunikácií Slovenskej republiky č.j. 9 – 101/2003 zo 07. 02. 2003 a na základe žiadosti spoločnosti:
This resolution is issued according to the authorisation by Ministry of Transport, Posts and Telecommunications of the Slovak Republic № 9 – 101/2003 dated 07.02.2003 and on the base of application of the company:

Indet Safety Systems, a.s.
Bobrky 462
755 01 Vsetín
Česká republika
Czech republic

Názov látky alebo predmetu:
Name of the substance or article:

Nedetonujúce pyrotechnické predmety s hmotnosťou pyrotechnickej zložde do 500 mg
Non-detonating pyrotechnic articles with weight *pyrotechnic composition up to the 500 mg*

Výrobca:
Manufacturer:

Indet Safety Systems, a.s.
Bobrky 462
755 01 Vsetín
Česká republika
Czech republic

Nedetonujúce pyrotechnické predmety s hmotnosťou pyrotechnickej zložde do 500 mg, v transportom puzdre, ktoré je vyrobené podľa dokumentácie ISV 2198, sú vyňaté z UN triedy 1 pretože nepredstavujú značné nebezpečenstvo výbuchu v súlade s „UN Recommendations on the Transport of Dangerous Goods - Model Regulations, Seventeenth revised edition 2011" bod 2.1.3.6.4.

Non-detonating pyrotechnic articles with weight pyrotechnic composition up to the 500 mg.in transport housing, which is made according to documentation ISV 2198, are excluded from UN Class 1 and desgnated as not presenting a significant hazard from explosion in accordance with „UN Recommendations on the Transport of Dangerous Goods - Model Regulations, Seventeenth revised edition 2011" point 2.1.3.6.4 .

Vyššie uvedená deklasifikácia platí tiež pre dopravu výbušnín podľa IMDG, ICAO TI, RID a ADN.
The above mentioned declassification is also valid for transport of explosives according to IMDG, RID, ICAO TI and ADN.

Dátum a miesto vydania: 11. 12. 2014, Dubnica nad Váhom
Date and place of issue:

NOTIFIKOVANÁ OSOBA 1395 NOTIFIED BODY KONŠTRUKTA-Defence, a.s. PSS Lieskovec, Dubnica n.V.

Ing. Daniel Nemček
riaditeľ SKTC – 112
Director of SKTC – 112

063581

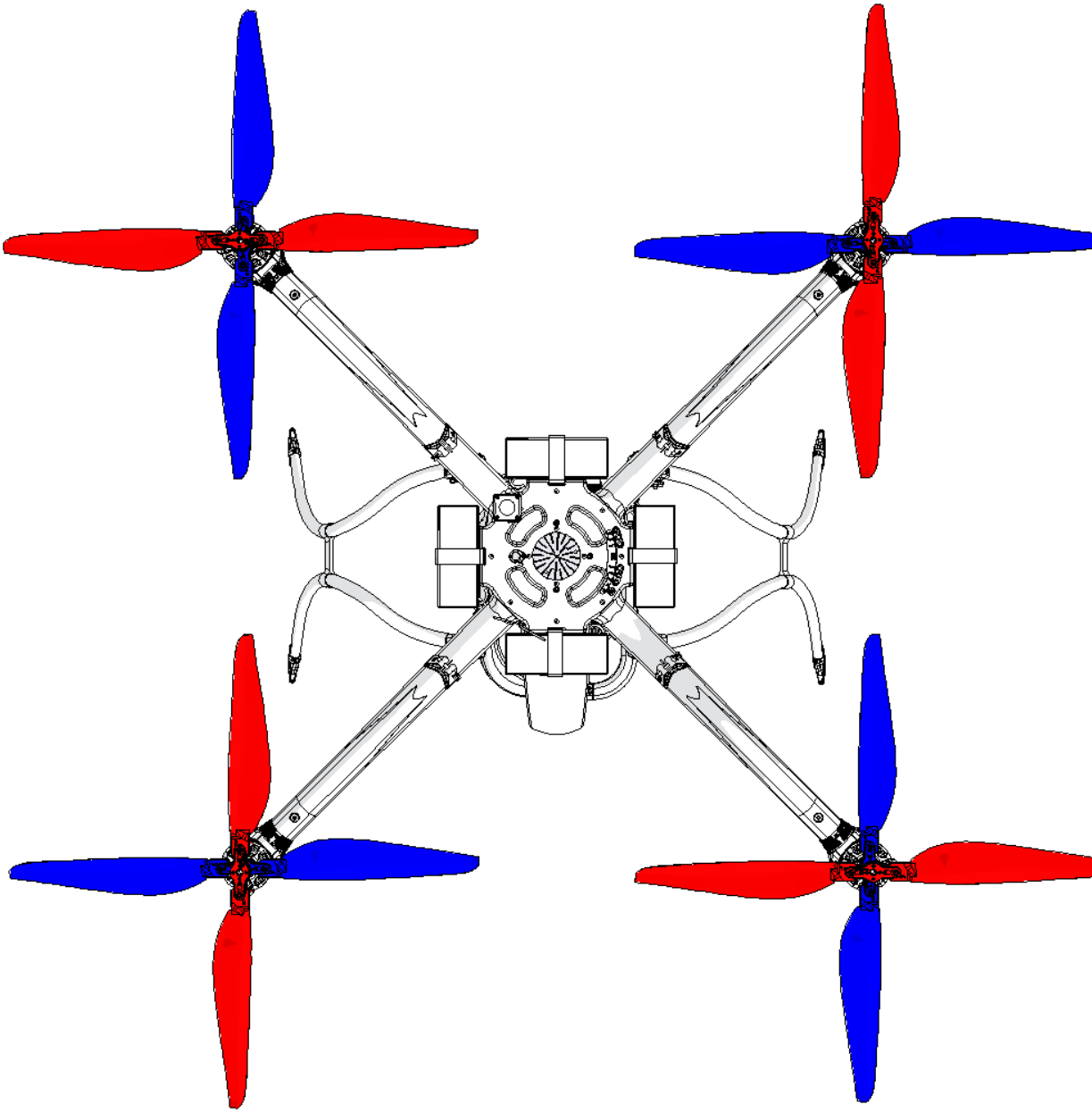
ANNEX NO. 3 – RECORD OF SYSTEM USE

The manufacturer recommends recording every use of the system including the entire system inspection carried out, especially, in case that the unmanned aerial vehicle is operated alternatively by more persons.

NUMBER OF USES	DATE	INSPECTION CARRIED OUT	SIGNATURE
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

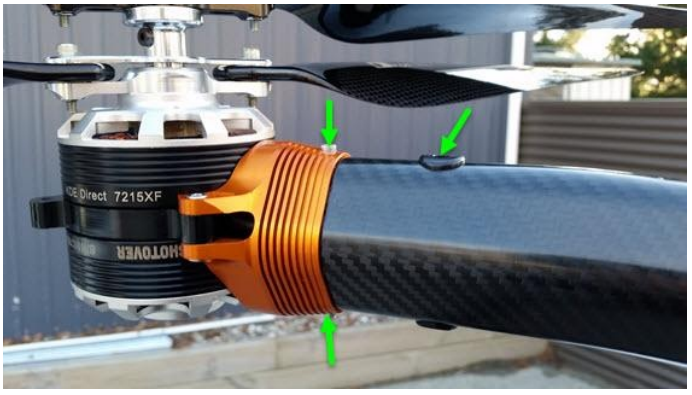
Appendix G. U1 Motor Assembly Replacement

Important: The motor assemblies from arm 1 and 3 (odd numbered arms) are interchangeable, likewise 2 and 4 (even numbered arms) are interchangeable. Do not fit an odd numbered motor assembly to an even numbered arm without following procedure 2.



Motor Replacement

1. Remove the arm from the hub, disconnect the power and signal wires. If arm 2 or 4 is being removed, cut the heat shrink surrounding the antenna cable connector and disconnect it also.
2. Remove the 3 screws shown below, remove the plastic sleeves that hold the long m3 screw and nut.



3. Pull the motor assembly from the carbon arm. In some cases, it can be a tight fit. The antenna may need to be removed, as it can obstruct the wires.
4. Ensure the new motor assembly is the correct number for the arm.
5. Fit the motor assembly, loosely fit all screws. The plastic spacers will only fit in one orientation, ensure the spacers sit nicely on the arm before tightening all screws.
6. Refit the arm ensuring the ESC wires are plugged in correctly. The white wire is indicated by the white paint on the female connector. The ESC with the blue heat shrink will mate with the connector that has the blue dot, likewise with the red connector.

Always check the motors are spinning in the correct direction before attempting to take off.

Swapping an odd numbered motor to an even numbered arm

1. Install and open the KDE software.
2. Connect the KDE ESC programming tool (provided with your U1) to the short Orange ESC wire. If the KDE software shows two green lights in the ‘Connection Status’ window proceed to step 4.
3. Power the ESC with any voltage from 12v to 48v (remove the props).
4. In the KDE software go to ‘File’, ‘Load Advanced Settings’ and select the config file that matches the arm the motors will be fitted to. ‘KDEesc_Arm1_3’ is for Arm 1 and 3.
5. Select ‘Open’.
6. The config file will load into the software. Select ‘Send Settings’ to upload the file to the ESC.
7. Repeat this process for the second ESC.
8. Follow steps 4 thru 6 in the motor replacement section to refit the motor assembly.

Appendix H. SHOTOVER Do's and Don'ts

IMPORTANT things to avoid and/or to look out for while working with your SHOTOVER U1. Damage sustained through improper use will void the warranty.

- ALWAYS follow static control procedures when in proximity of an exposed circuit board.
- ALWAYS route all system cabling in such a way as to ensure they cannot be damaged.
- ALWAYS have the camera system serviced by qualified personnel only.
- ALWAYS make sure all components are free of dust or foreign objects before powering on.
- ALWAYS install locking pins for any kind of transportation.
- ALWAYS torque all screws/bolts to the values specified in instructions or specified in Appendix A.
- ALWAYS ensure all screws/bolts are the correct length.
- DO NOT ignore safety warnings and cautions on both the equipment and in this manual.
- DO NOT disable any safety features of the system.
- DO NOT power on without a balanced payload fitted.
- DO NOT power on without proper grounding of the system.
- DO NOT power on with locking pins fitted.
- DO NOT power on if there is not adequate clearance for the full range of motion of the Gimbal.
- DO NOT ship/transport a Gimbal with the payload fitted.
- DO NOT use accessories or attachments unless recommended by SHOTOVER Camera Systems.
- DO NOT cover fan openings in the Ground Station.
- DO NOT use replacement parts which are not factory specified.
- DO NOT exceed the maximum speeds as specified by manufacturer for the mount you will be using.
- DO NOT clean the carbon fibre with harsh solvents.
- DO NOT leave any screws loose or not torqued properly
- DO NOT work on a Gimbal which has not been mounted securely.

Appendix I. U1 Series II Propulsion System Specifications

Dimensions
- Height: 863mm
- Width: 1103mm (without props), 1122mm (with props)
- Wingspan: 1590mm (without props) 2349.5mm (with props)

Flight Time
- Up to 9-22min *dependent on setup

Power
- 500 Amps Max Draw (at 44V)

Operating Temperature
- -20 to +40 °C (-4 to 104 °F).

Weight
- Empty weight (without batteries): 19.4kg
- Payload weight: Max 30g
- Total weight: 60kg

Motors
- Co-axial configuration
- Two independent T-Motor U12 II KV120 motors per rotor arm.
- Kv: 120 RPM/V
- Maximum Continuous Current: 95+A
- Maximum Continuous Power: 4560+W
- Voltage Range: 50V (12S) (44V nominal)
- Weight: 778 g with wires/bullets
- Maximum Thrust Output: 20,400g
- Maximum Power Input: 4742W
- RPM: 4742 rev/min

*** Notes:**

b) These values are drawn from T-Motors, and are obtained under their specific testing conditions. For more detailed specs: https://store-en.tmotor.com/goods.php?id=736

c) Each motor can be controlled independently allowing for control of each prop independently

Overall Specifications:
- Maximum Thrust: 359 lbs. or 280% lift power.
- Type: Direct connection
- Motor Fixation: Rigid
- Diameter of the Fittings: 5mm (M5)

Propellers
- Model: T-Motor G30X10.5
- Type: Rigid
- Number of blades: 8
- Diameter: 30 inches
- Pitch: 10.5 degrees
- Blade Material: Carbon Fibre
- Hub Material: Carbon Fibre
- Manufacturer: T-Motor
- Fitting : 4 type M4 x 16mm

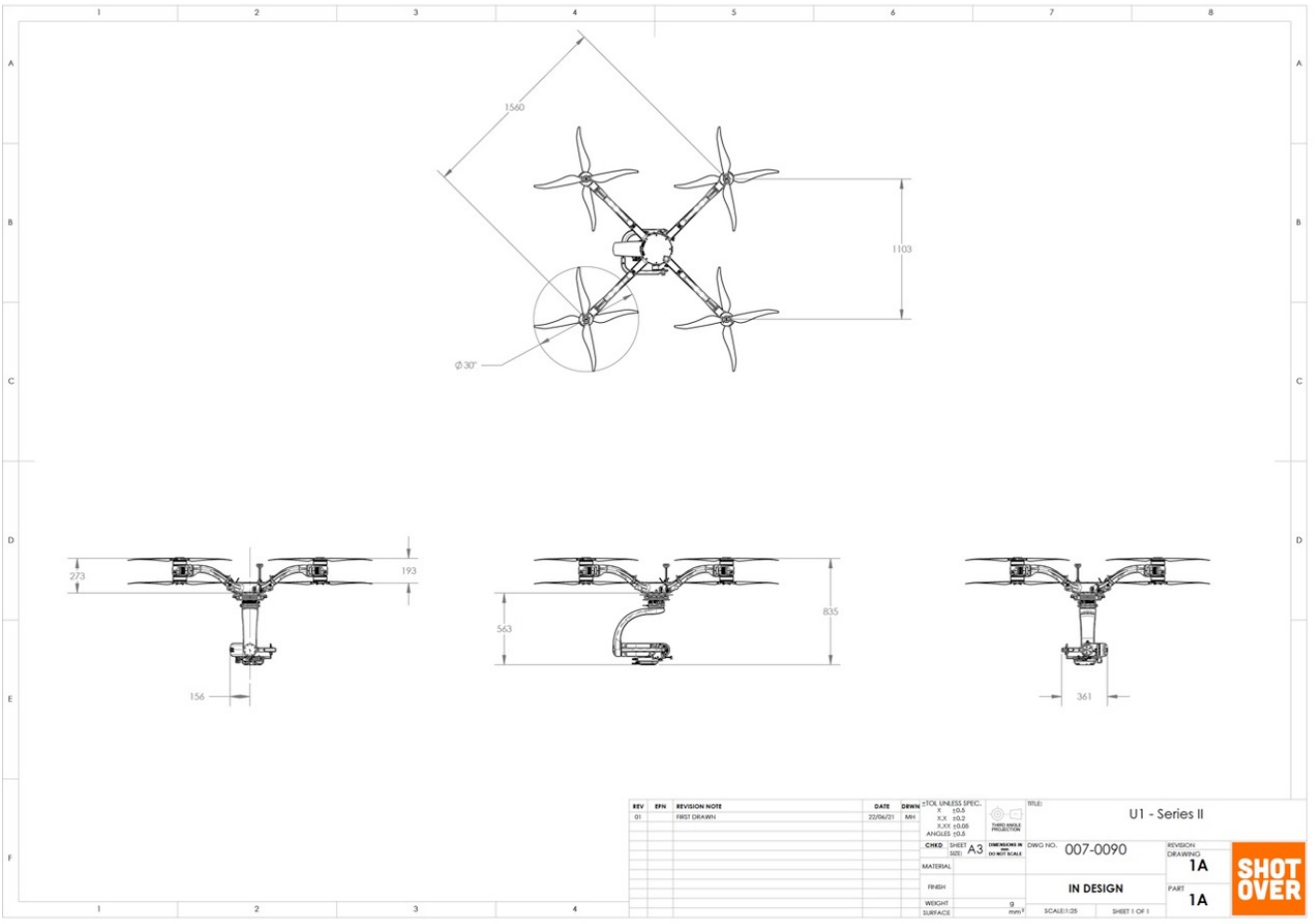
*** Notes:**

c) Consequently, the U1 Multirotor will have four pairs of CW rotating propellers and 4 pairs of CC rotating propellers.

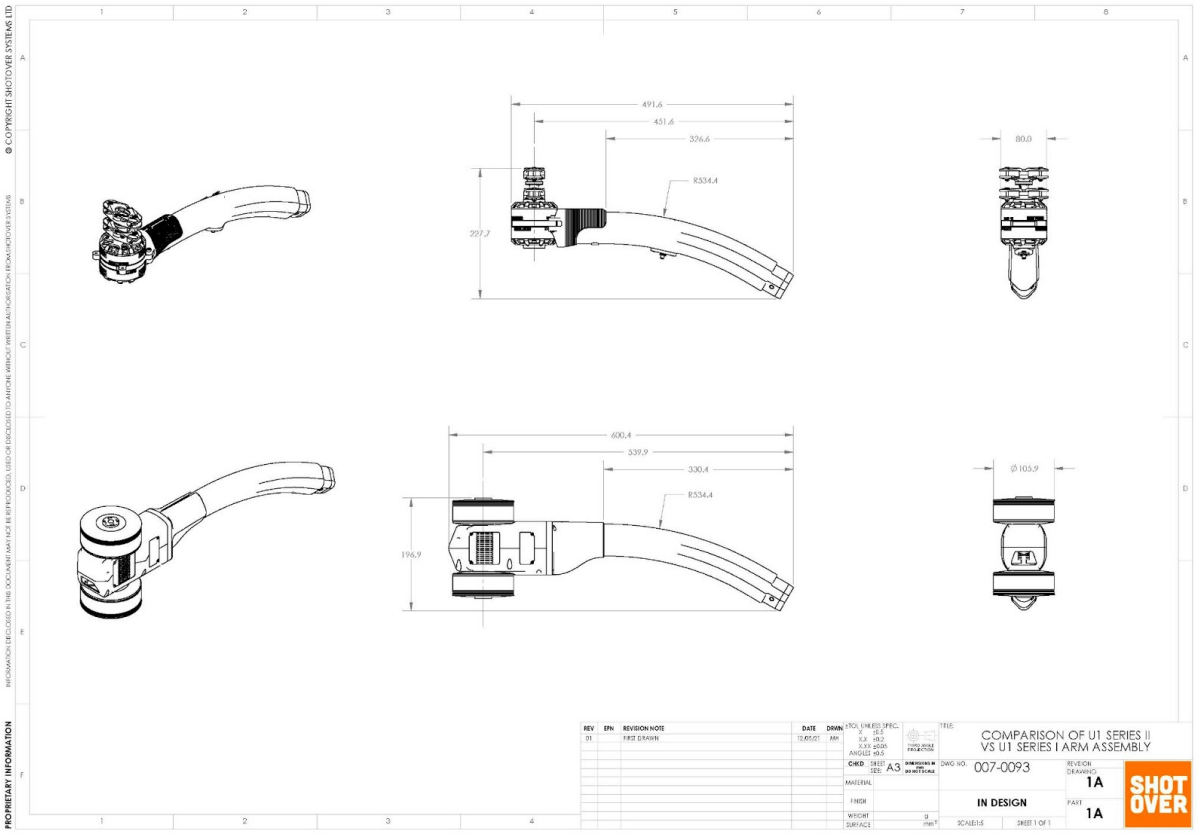
d) As long as the relative dimensions are similar and the alternative propellers fit onto the motor perfectly it is ok to use different propellers.

Recommended Environmental Operating conditions

- Rain: Nil
- Wind: 65 km/h (max)
- Snow: Nil
- Hail: Nil
- Altitude: 8000ft



Appendix J. Comparison of U1 Series I vs. Series II Arm Assembly



Support

For technical documents, spares and assistance please visit www.shotover.com/service and use your login provided when you purchased your system.

Alternatively, you can contact SHOTOVER Customer Service on:

Phone. +64 3 746 7531 (24-hour Hotline)
Fax. +64 3 451 1487
Email. support@shotover.com

SHOTOVER HQ
133 Glenda Drive,
Queenstown 9300,
New Zealand

SHOTOVER Service Centres

- Los Angeles
- Frankfurt

11 DISCLAIMER

SHOTOVER Camera Systems makes no representations or warranties with respect to the contents hereof and specifically disclaims any implied warranties of merchantability of fitness for any particular purpose.

The information provided in this Manual is subject to change without notice. SHOTOVER Camera Systems reserves the right to revise this publication and to make changes from time to time in the content hereof without obligation to notify any person of such revision or changes.

Every precaution has been taken in the preparation of this Manual. Nevertheless, SHOTOVER Camera Systems assumes no responsibility for errors or omissions or any damages resulting from the use of the information contained herein.

If in doubt, you can ALWAYS contact SHOTOVER Service and Support.

Product Warranty

SHOTOVER warrants the SHOTOVER U1 (the “Warranty Products”), against defects in materials and workmanship for a one (1) year period from the date of shipping (“Warranty Period”). SHOTOVER’s sole obligation under this Limited Warranty is to repair or replace, at SHOTOVER’s sole opinion, any Warranty Products that are returned to SHOTOVER during the Warranty Period and that SHOTOVER determines are defective. This limited Warranty is VOID if SHOTOVER finds any signs of crash, damage, abuse, overloading, incorrect component matching, incorrect wiring, reverse polarity or negligence by the user. This Limited Warranty DOES NOT cover independent performance testing, research and product development. An official Return Material Authorization (RMA) number will be issued for your request via e-mail, and must be placed on the return shipment label (or clearly marked on the box) for proper processing. Please refer to all enclosed manuals and product pages on the SHOTOVER website (www.shotover.com) for proper use, requirements and maintenance schedules. If proper maintenance is not performed as required, items may not be covered under the terms of this Limited Warranty.

This Limited Warranty is VOID for all purchases from non-authorised resellers or third-party sales (second-hand owners). Refunds are not granted under this Limited Warranty.

This policy does not cover the following:

- Crash or fire damage caused by non-manufacturing factors, including but not limited to, pilot errors.
- Damage caused by unauthorized modification, disassembly, or maintenance not in accordance with official instructions or manuals.
- Damage caused by improper installation and incorrect use or operation not in accordance with the official instructions or manuals.
- Damage caused by a non-authorized service provider.
- Damage caused by unauthorized circuit modification and mismatch or misuse of batteries or charger.
- Damage caused by flights which did not follow the owners manual recommendations.
- Damage caused by operation in bad weather (i.e. strong wind, rain, sand/dust storms, etc.)
- Damage caused by operating the product in an environment with electromagnetic interference (i.e. a mining areas, close to radio transmission towers, high-voltage wires, substations, etc.).
- Damage caused by operating the product in an environment containing interference from other wireless devices (i.e. transmitter, video-link, Wi-Fi signals, etc.).
- Damage caused by operating the product at a weight greater than the safe take-off weight as specified by the owners manual.
- Damage caused by a flight in which damaged components or components suffering from natural wear and tear were used.
- Damage caused by reliability or compatibility issues when using unauthenticated third-party parts.
- Damage caused by operating the product with a low-charged or defective battery.
- Damage caused during uninterrupted or error-free operation of a product.
  Loss of, or damage to, your data by a product.
- Damage caused by any software incompatibility issues.
- Failure of, or damage caused by, any third-party products, including those that SHOTOVER may provide or integrate into the SHOTOVER product at your request.
- Products or parts with an altered identification label or from which the identification label has been removed.
- Failure of, or damage caused by, any third-party components used in the manufacture of SHOTOVER products, (including but not limited to; motors, flight controllers, propeller blades, sensors and radio equipment).

Notes